FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2025
CONCEPT RECAPITULATION TEST – IV
PAPER –1
TEST DATE: 24-04-2025

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

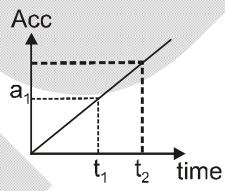
PART – I

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 particle is projected from ground At a height of 0.4 m from the ground, the velocity of a projectile in vector form is $\vec{v} = (6\hat{i} + 2\hat{j})$ m/s (the x-axis is horizontal and y-axis is vertically upwards). The angle of projection is ($g = 10\ m/s^2$):
   (A) 45° (B) 60°
   (C) 30° (D) $\tan^{-1}(3/4)$

2. Acceleration time graph of a particle is shown. Work done by all the forces acting on the particle on the particle of mass m in time interval from t_1 to t_2 while a_1 is the acceleration at time t_1, is given by:



   (A) $\frac{ma_1^2}{4t_1}(t_2^3 - t_1^3)$ (B) $\frac{ma_1^2}{8t_1^2}(t_2^4 - t_1^4)$
   (C) $\frac{ma_1^2}{4t_1^2}(t_2^4 - t_1^4)$ (D) $\frac{ma_1}{2t_1}(t_2^2 - t_1^2)$

3. In a Young's double slit experiment, the slit separation is 1 mm and the screen is 1 m from the slit. For a monochromatic light of wavelength 500 nm, the distance of 3rd minima from the central maxima is
   (A) 0.50 mm (B) 1.25 mm
   (C) 1.50 mm (D) 1.75 mm

4. The K_α X-ray emission line of tungsten occurs at λ = 0.021 nm. The energy difference between K and L levels in this atom is about
   (A) 0.51 MeV (B) 1.2 MeV
   (C) 59 KeV (D) 13.6 eV

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. The potential energy of a particle moving along x-axis is given by U = 20 + 5 sin(4πx) where U is in J and x is in metre under the action of conservative force :
   (A) at x = 7/8m, particle is at equilibrium.
   (B) at x = 7/8 m, particle is not at equilibrium.
   (C) x = 3/8m, particle is at equilibrium.
   (D) x = 3/8 m, particle is not at equilibrium.

6. A bimetallic strip is formed by two identical strips, one of copper and the other of brass. The coefficients of linear expansion of the two metals are α_C and α_B. On heating, the temperature of the strip goes up by ΔT and the strip bends to from an arc of radius of curvature R. Then R is

(A) proportional to ΔT (B) inversely proportional to ΔT

(C) proportional to $|\alpha_B - \alpha_C|$ (D) inversely proportional to $|\alpha_B - \alpha_C|$

7. The distance between an object and the screen is 100 cm. A lens produces an image on the screen when placed at either of the positions 40 cm apart. The power of the lens is nearly and the magnification will

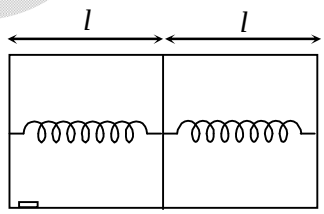
(A) $\frac{21}{100}$ dioptres (B) $\frac{100}{21}$ dioptres

(C) $-\frac{3}{7}$ (D) $-\frac{7}{3}$

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. A horizontal thermally insulated cylinder of length 2l is separated by a thin insulating piston dividing the cylinder in two equal parts. The piston is connected by ideal springs and initially springs are non-deformed. Left part contains 2 moles of H_2 and right part contains 2 moles of O_2 at same initial temperature. The left part of the cylinder is fitted with a thermostat which maintains the constant temperature of the gas and through which only heat transfer can take place. The following two processes are performed on the given system. After process I, the system is brought back to its initial state.



Process I: Heat Q is supplied to the right part and piston is displaced to the left by a distance l/2.

Process II: Heat Q is given to the right part and as a result piston displaces to the left by a distance l/2. The gas on the left dissociates into its atoms.

List-I		List-II	
(P)	In process I	(1)	Temperature of the gas on left remains constant.
(Q)	In process I, if piston displaces to the right by same amount.	(2)	Heat is rejected by the gas on the left.
(R)	In process II	(3)	Total work done by both the gases is positive.
(S)	In process II if partial dissociation has taken place	(4)	Heat is absorbed by the gas on the left.

The correct option is:

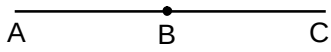
(A) P $\rightarrow$ 1,2,3 ; Q $\rightarrow$ 1,3 ; R $\rightarrow$ 1,2,4 ; S $\rightarrow$ 1,3,4

(B) P $\rightarrow$ 1,2,3 ; Q $\rightarrow$ 1,3,4 ; R $\rightarrow$ 1,2,3 ; S $\rightarrow$ 1,2,3

(C) P $\rightarrow$ 1,2,3 ; Q $\rightarrow$ 1,2,3 ; R $\rightarrow$ 1,2,3 ; S $\rightarrow$ 1,3,4

(D) P $\rightarrow$ 1,2,3 ; Q $\rightarrow$ 1,2 ; R $\rightarrow$ 1,3,4 ; S $\rightarrow$ 1,2,3

9. A long wire ABC is made by joining two wires AB and BC of equal area of cross section. AB has length 4.8 m and mass 0.12 kg while BC has length 2.56 m and mass 0.4 kg. The wire is under a tension of 160 N. A wave Y (in cm) = 3.5 sin (kx – wt) is sent along ABC from end A. No power is dissipated during propagation of wave.



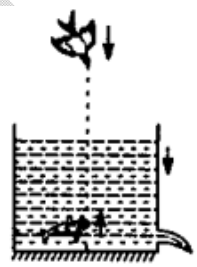
List-I		List-II	
(P)	Amplitude of reflected wave	(1)	2.0
(Q)	Amplitude of transmitted wave	(2)	1.5
(R)	Maximum displacement of antinodes in the wire AB	(3)	5
(S)	Percentage fraction of power transmitted in the wire BC	(4)	82
		(5)	92

The correct option is:

(A) P $\rightarrow$ 2 ; Q $\rightarrow$ 1 ; R $\rightarrow$ 3 ; S $\rightarrow$ 4 (B) P $\rightarrow$ 2 ; Q $\rightarrow$ 1 ; R $\rightarrow$ 4 ; S $\rightarrow$ 5

(C) P $\rightarrow$ 2 ; Q $\rightarrow$ 1 ; R $\rightarrow$ 4,5 ; S $\rightarrow$ 3 (D) P $\rightarrow$ 2 ; Q $\rightarrow$ 1 ; R $\rightarrow$ 1,5 ; S $\rightarrow$ 4

10. A bird in air is diving vertically over a tank with speed 6 cm/s. Base of tank is silvered. A fish in the tank is rising upward along the same line with speed 4 cm/s. Water level is falling at rate of 2 cm/s. (take: μ water = 4/3)



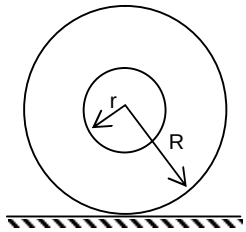
List-I		List-II	
(P)	Speed of the image of fish as seen by the bird directly (Apparent)	(1)	12
(Q)	Speed of the image of fish formed after reflection fro the mirror as seen by the bird.	(2)	4
(R)	Speed of image of bird relative to the fish looking upwards	(3)	9
(S)	Speed of image of bird relative to the fish looking downwards in the mirror	(4)	3
		(5)	5

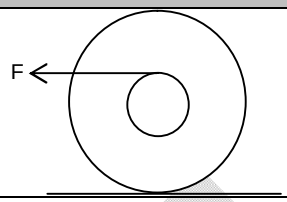
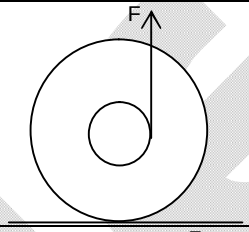
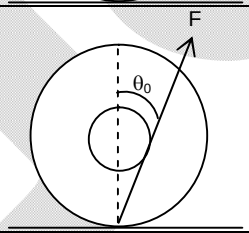
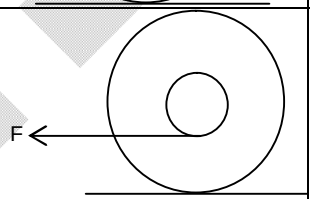
The correct option is:

(A) P $\rightarrow$ 3 ; Q $\rightarrow$ 2 ; R $\rightarrow$ 5 ; S $\rightarrow$ 1 (B) P $\rightarrow$ 3 ; Q $\rightarrow$ 4 ; R $\rightarrow$ 1 ; S $\rightarrow$ 2

(C) P $\rightarrow$ 1 ; Q $\rightarrow$ 2 ; R $\rightarrow$ 5 ; S $\rightarrow$ 1 (D) P $\rightarrow$ 5 ; Q $\rightarrow$ 4 ; R $\rightarrow$ 1 ; S $\rightarrow$ 2

11. A heavy spool of mass M and radii r and R of axle and spool respectively is resting on rough surface so that there is no any relative motion between points of contact. An ideal string is wound on the axle. The string is continuously pulled by applying force F. There is no slipping between string and axle friction. Match the list-I with list-II. ($I = MR^2$)



List – I			List – II	
(P)	Force F is applied to string towards left and spool rolls without slipping		(1)	$\alpha = \frac{F(r+R)}{2MR^2}$
(Q)	Force F = Mg is applied vertically upwards		(2)	$\alpha = \frac{F(R-r)}{2MR^2}$
(R)	Force F applied at angle θ_0 with vertical so that line of force passes through point of contact		(3)	$\alpha \neq 0, a_{cm} = 0$
(S)	Force F is applied to string towards left and spool rolls without slipping		(4)	$\alpha \neq 0, a_{cm} \neq 0$ or $\alpha = 0, a_{cm} = 0$

The correct option is:

(A) P → 1,4 ; Q → 2 ; R → 1 ; S → 2,4 (B) P → 1,4 ; Q → 4 ; R → 4 ; S → 2,4

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

SECTION – B
(Numerical Answer Type)

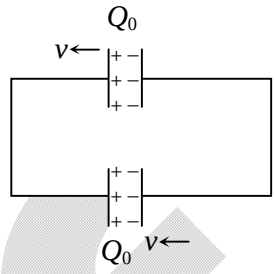
*This section contains **SIX (06)** Numerical based questions. The answer to each question is a **NON-NEGATIVE INTEGER VALUE**.*

12. Power supplied to a particle of mass 2 kg varies with time as $P = \frac{3t^2}{2}$ W. Here t in second.

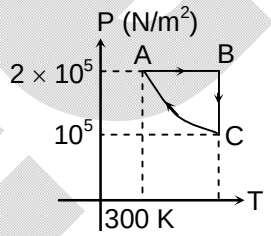
If velocity of particle at t = 0 is v=0. Find the velocity (in m/sec) of the particle at time t = 2Sec.

13. A drop of water of mass m = 0.4 g is placed between two clean glass plates, the distance between which is 0.01 cm. If the force needed to hold one of the plates is 3.2x N, find 'x'. (Surface tension of water = 0.08 N/m).

14. Two identical capacitor connected as shown and having initial charge Q_0. Separation between plates of capacitor is d_0. Suddenly the left plate of upper capacitor and right plate of lower capacitor start moving with speed v towards left while other plate of capacitor remains fixed. (given $\frac{Q_0 v}{2d}$ =1 amp). Find the value of current (in amp) in the circuit.

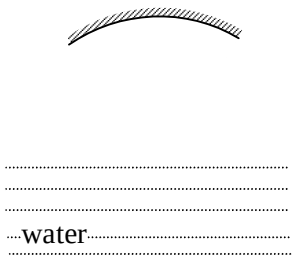


15. Two moles of a monatomic ideal gas is taken through a cyclic process shown on pressure(P)-temperature(T) diagram in figure. Process CA is represented as PT = Constant. If efficiency of given cyclic process is $1-\frac{4.2x}{12\ln 2+15}$, then find x.



16. In YDSE distance between the slits plane and screen is 1m and distance between two slits is 5 mm. If slabs of thickness 2mm and 1.5mm having refractive index 1.5 and 1.4 are placed in front of two slits, find the shift (in cm) of central maxima

17. A concave mirror of focal length 15 cm is placed in air at a height of 45 cm above the water surface as shown. The axis of the mirror is vertical and the reflecting surface faces the water surface. A point object is placed on the axis of concave mirror at a distance 35 cm above the water surface. Find the position of image formed after two successive processes- first reflection from the concave mirror and then first refraction from the water (reflective Index of water 4/3). The distance of image from water surface (in m) is:



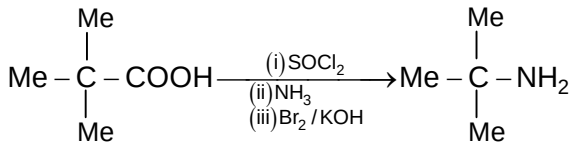
Chemistry

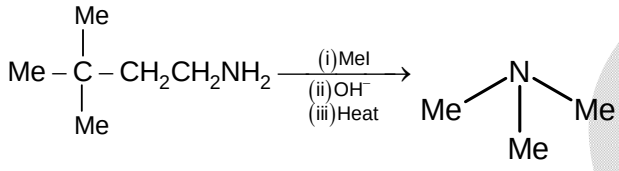
PART – II

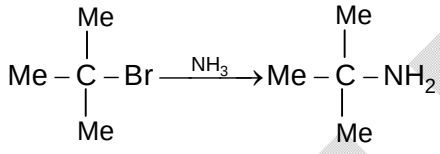
SECTION – A
(One Options Correct Type)

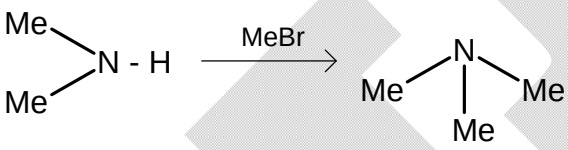
*This section contains **FOUR (04)** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.*

18. In which of the following reactions, the mentioned product is not formed?

(A) 

(B) 

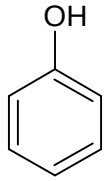
(C) 

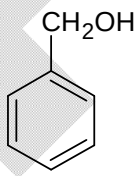
(D) 

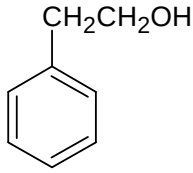
19. Which of the following is used to separate HF form a mixture of HF and N_2?
(A) AlF_3 (B) NaF
(C) SiF_4 (D) NF_3

20. The most acidic substance out of the following is

(A) 

(B) 

(C) 

(D) 

21. Correct acidic strength order is
(A) $CHF_3 > CH_4 > CHCl_3$ (B) $CHF_3 > CHCl_3 > CH_4$
(C) $CHCl_3 > CH_4 > CHF_3$ (D) $CHCl_3 > CHF_3 > CH_4$

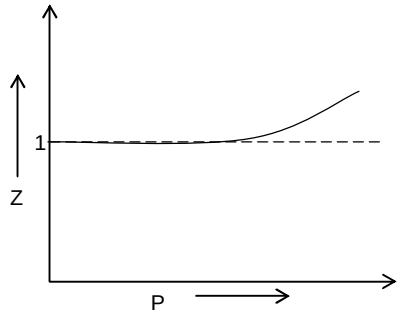
SECTION – A
(One or More than one correct type)

*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).*

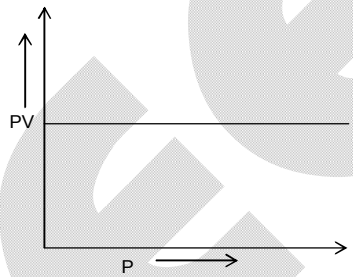
22. Which of the following product(s) is/are formed by decomposition of barium amide, $Ba(NH_2)_2$?
(A) Ba
(B) Ba_3N_2
(C) NH_3
(D) $Ba(N_3)_2$

23. Which of the following curve(s) is/are correct at Boyle temperature? [Z = compressibility factor]

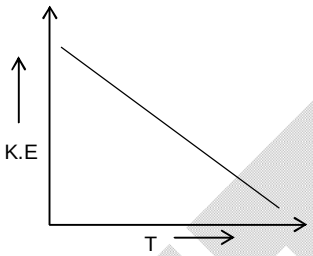
(A)



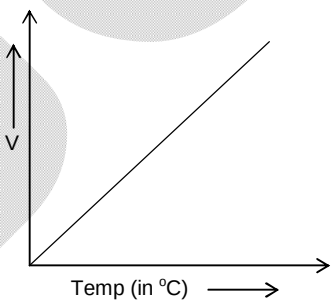
(B)



(C)



(D)



24. Which of the following is/are correct option?
(A) Tetrapeptide represents, 4 peptide bond in a molecule of polypeptide.
(B) Glucose & Fructose can be differentiated by Tollen's reagent & Fehling's solution.
(C) One mole of glucose reacts with maximum of 3 mole of phenylhydrazine.
(D) Sucrose is the only disaccharide which is reducing in nature.

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.*

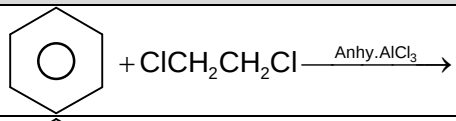
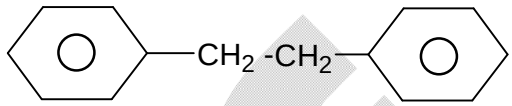
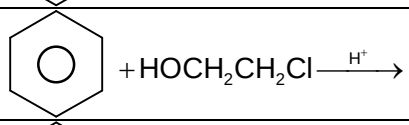
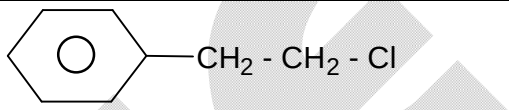
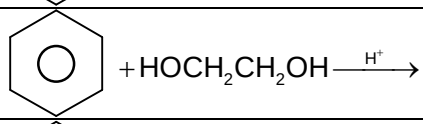
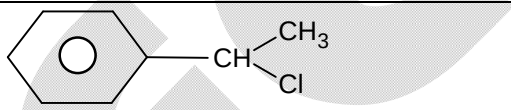
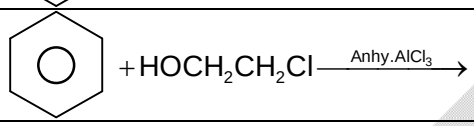
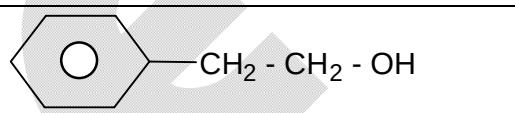
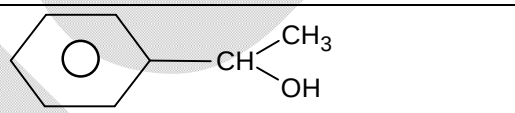
25. Match the lists.

List – I		List – II	
(P)	NaOH	(1)	Used in Solvay process
(Q)	NaCl	(2)	Produced in Solvay process
(R)	Na_2CO_3	(3)	Evolves O_2 gas on thermal decomposition
(S)	$NaNO_3$	(4)	Is not stored in aluminium container

		(5)	Produced during electrolysis of aqueous NaCl solution

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

26. Match the lists

List – I		List – II	
(P)		(1)	
(Q)		(2)	
(R)		(3)	
(S)		(4)	
		(5)	

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

27. Match the lists

List – I (Reagents used to determine the structure of glucose)		List – II (Information obtained about glucose)	
(P)	Br_2/H_2O	(1)	Glucose contains five OH groups
(Q)	Conc.HI/red phosphorus	(2)	Glucose contains a carbonyl group
(R)	$(CH_3CO)_2O$	(3)	Glucose contains an aldehyde group
(S)	HCN	(4)	Glucose contain a straight chain of six carbon atoms
		(5)	Glucose contains a keto group.

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

28. Match the lists

List – I (Nitrogen oxides)		List – II (Properties)	
(P)	NO_2	(1)	imparts colour when heated in presence of air
(Q)	N_2O_3	(2)	Lose colour upon cooling under pressure
(R)	N_2O_5	(3)	Two nitrogen oxide are formed upon decomposition
(S)	NO	(4)	Conduct electricity in molten as well as aqueous state
		(5)	Behaves as a mixed anhydride of two different oxy-acids

(A) P $\rightarrow$ 1; Q $\rightarrow$ 2; R $\rightarrow$ 3; S $\rightarrow$ 4
(B) P $\rightarrow$ 2; Q $\rightarrow$ 3; R $\rightarrow$ 4; S $\rightarrow$ 1
(C) P $\rightarrow$ 3; Q $\rightarrow$ 4; R $\rightarrow$ 1; S $\rightarrow$ 2
(D) P $\rightarrow$ 4; Q $\rightarrow$ 5; R $\rightarrow$ 2; S $\rightarrow$ 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**.*

29. A saturated solution of $Ca(OH)_2$ has pH = 12, the solubility product of $Ca(OH)_2$ is $x \times 10^{-7}$ then value of x is

30. If the ratio of the wavelengths of the first line of Balmer series in H-atom and in He^+ ion is expressed as x : y, what is the value of (x + y)?

31. In fluorine molecule(F_2)
a = the number of electrons present in its highest energetic molecular orbital(s).
b = the number of electrons present in all the antibonding molecular orbital.
c = bond order of the molecule.
d = number of electrons present in the pi-bonding molecular orbitals.
What is the value of (a + b + c + d)?

32. The ionization constant K_a of a weak monobasic acid(HA) is 10^{-6}. The ionization constant K_b of a weak monoacidic base BOH is 10^{-8}. What is the pH of the aqueous solution of AB at 298 K.

33. P_4O_{10} undergoes complete hydrolysis in excess water producing an acid(A). On heating the aqueous solution of (A), dehydration leads to formation of another acid(B) and H_2O. If the oxidation of phosphorus in (A) is +x and that in (B) is +y, what is the value of (x+y)?

34. The molecular formula of glucose is $C_6H_{12}O_6$. It shows x number of optical isomers. Let one of the optical isomers of glucose is (A). The maximum number of diastereomer pairs possible for (A) is 'y'. The number of enantiomers of (A) is 'z'. What is the value of (x + y + z)?

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. The value of $\sum_{r=0}^{50}(-1)^r \frac{^{50}C_r}{r+2}$ is equal to

(A) $\frac{1}{50\times 51}$ (B) $\frac{1}{52\times 50}$

(C) $\frac{1}{52\times 51}$ (D) none of these

36. If $x_1=\sqrt{3}$ and $x_{n+1}=\frac{x_n}{1+\sqrt{1+x_n^2}}, \forall n\in N$, then $\lim_{x\to\infty} 2^n x_n$ equal to

(A) $\frac{3}{2\pi}$ (B) $\frac{2}{3\pi}$

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

37. Let $f(x)=\max\left\{\left|x^2-2|x|\right|,|x|\right\}$ and $g(x)=\min\left\{\left|x^2-2|x|\right|,|x|\right\}$, then

(A) both $f(x)$ and $g(x)$ are non – differentiable at 5 points.

(B) $f(x)$ is not differentiable at 5 points and $g(x)$ is non – differentiable at 7 points.

(C) number of points of non – differentiability for $f(x)$ and $g(x)$ are 7 and 5 points respectively.

(D) both $f(x)$ and $g(x)$ are non – differentiable at 3 and 5 points respectively

38. $\sin^{-1}\frac{1}{\sqrt{2}}+\sin^{-1}\left(\frac{\sqrt{2}-\sqrt{1}}{\sqrt{6}}\right)+\ldots+\sin^{-1}\left(\frac{\sqrt{n}-\sqrt{n-1}}{\sqrt{n(n+1)}}\right)+\ldots..\infty=$

(A) 0 (B) $\frac{\pi}{4}$

(C) $\frac{\pi}{2}$ (D) $\frac{3\pi}{4}$

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. Given that the two curves $\arg(z)=\frac{\pi}{6}$ and $|z-2\sqrt{3}i|=r$ intersect in two distinct points, then

(A) $[r]\neq 2$ (B) $0<r<3$

(C) $r=6$ (D) $3<r<2\sqrt{3}$

($[r]$ represents integral part of r)

40. A function f is defined by $f(x)=\int_0^{\pi}\cos t\cos(x-t)\,dt,\ 0\le x\le 2\pi$, then which of the following hold(s) good?

(A) $f(x)$ is continuous but not differentiable in $(0, 2\pi)$

(B) Maximum value of f is π

(C) There exists at least one $c\in(0, 2\pi)$ such that $f'(c)=0$

(D) Minimum value of f is $-\frac{\pi}{2}$

41. If $\int_0^{\alpha}\frac{dx}{1-\cos\alpha\cos x}=\frac{A}{\sin\alpha}+B\,(\alpha\neq 0)$, then possible values of A and B are

(A) $A=\frac{\pi}{2}, B=0$ (B) $A=\frac{\pi}{4}, B=\frac{\pi}{4\sin\alpha}$

(C) $A=\frac{\pi}{6}, B=\frac{\pi}{\sin\alpha}$ (D) $A=\pi, B=\frac{\pi}{\sin\alpha}$

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. The equation $z^n-1=0$ has n roots which are called the nth roots of unity. The n, nth roots of unity are $1,\alpha,\alpha^2,.....,\alpha^{n-1}$ which are in GP, where

$\alpha=\cos\left(\frac{2\pi}{n}\right)+i\sin\left(\frac{2\pi}{n}\right);\ i=\sqrt{-1}$ then we have following results:

(i) $\sum_{r=0}^{n-1}\alpha^r=0$ or $\sum_{r=0}^{n-1}\cos\left(\frac{2\pi r}{n}\right)=0$ and $\sum_{r=0}^{n-1}\sin\left(\frac{2\pi r}{n}\right)=0$

(ii) $z^n-1=\prod_{r=0}^{n-1}(z-\alpha^r)$

(iii) $\prod_{r=0}^{n-1}\alpha^r=(-1)^{n-1}$

(iv) $\sum_{r=0}^{n-1}\alpha^{kr}=\begin{cases} n, \text{ if } k \text{ is multiple of } n \\ 0, \text{ if } k \text{ is not multiple of } n \end{cases}$

On the basis of above information, answer the following questions:
Match each entry in **List – I** to the correct entry in **List – II**.

	List – I	List – II	
(P)	If the value of $\sum_{r=1}^{n-1}\frac{1}{(2-\alpha^r)}=\frac{(n+a)2^{n-1}+b}{2^n-1}$ then $a+b$ is	(1)	2
(Q)	If ω be non real complex cube root of unity, then the value of $\frac{\prod_{p=1}^{4}(\omega+\alpha^p)}{\prod_{q=1}^{7}(\omega^2-\alpha^q)}=\left(\frac{1+ia}{2}\right)$. The value of a is	(2)	3
(R)	If the algebraic sum of perpendicular distances from the points $1,\alpha,\alpha^2,\alpha^3,.....\alpha^{n-1}$ to the line $\bar{a}z+a\bar{z}+b=0$, (where a is complex number and b is real) is equal to $\frac{nb}{\lambda\lvert a\rvert}$, then λ is	(3)	$-\sqrt{3}$
(S)	If $\alpha=\cos\left(\frac{2\pi}{7}\right)+i\sin\left(\frac{2\pi}{7}\right)$, then equation whose roots are $\alpha+\alpha^2+\alpha^4$ and $\alpha^3+\alpha^5+\alpha^6$ is $z^2+\lambda z+\mu=0$. Then $\lambda+\mu$ is	(4)	$\sqrt{3}$
		(5)	–1

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

43. If $7l^2-9m^2+8l+1=0$ and we have to find equation of circle having $lx+my+1=0$ is a tangent and we can adjust given condition as $16l^2+8l+1=9(l^2+m^2)$

or $(4l+1)^2=9(l^2+m^2)$ $\Rightarrow$ $\frac{|4l+1|}{\sqrt{(l^2+m^2)}}=3$

Centre of circle = (4, 0) and radius = 3.
When any two non parallel lines touch a circle, then centre of circle lies on angle bisector of lines.
On the basis of above information, answer the following questions:
Match each entry in **List – I** to the correct entry in **List – II**.

	List – I	List – II	
(P)	If $16m^2-8l-1=0$, then equation of the circle having $lx+my+1=0$ as a tangent is $x^2+y^2+\lambda x=0$. The value of λ is	(1)	2
(Q)	If $16l^2+9m^2=24lm+6l+8m+1$ and if S be the equation of the circle having $lx+my+1=0$ as a tangent then the equation of director circle of S is $x^2+y^2+\lambda x-\mu y=25$. The value of $\lambda+\mu$ is	(2)	8

(R)	If $4l^2 - 5m^2 + 6l + 1 = 0$, then the centre and radius of the circle which have $lx + my + 1 = 0$ as a tangent is $(\lambda, 0); \sqrt{\mu}$. The value of $\lambda + \mu$ is	(3)	–8
(S)	If $x + 2y = 3$ and $2x + y = 3$ touches a circle whose centre lies on a line $3x + 4y = 5$, then possible centres of circle are $\left(\frac{5}{7}, \frac{5}{7}\right)$ and (λ, μ). Then the value of $\lambda + \mu$ is	(4)	1
		(5)	–2

The correct option is

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

44. Different words are being formed by arranging the letters of the word "SUCCESS". All the words are obtained by writing in the form of a dictionary.

On the basis of above information, answer the following questions:

Match each entry in **List – I** to the correct entry in **List – II**.

	List – I	**List – II**	
(P)	The number of words in which the two Cs are together but no two Ss are together is	(1)	24
(Q)	The number of words in which no two Cs and no two Ss are together is	(2)	42
(R)	The number of words in which the consonants appear in alphabetic order is	(3)	330
(S)	The rank of the word "SUCCESS' in the dictionary is	(4)	96
		(5)	331

The correct option is

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

45. Newton's law of cooling states that the rate at which a substance cools in moving air is proportional to the difference between the temperatures of the substance and that of the air. If the temperature of the air is 290K, we can write it as $\frac{dT}{dt} = -k(T - 290), k > 0$ constants, where T is temperature of substance. The substance cools from 370 K to 330 K in 10 min.

On the basis of above information, answer the following questions:

Match each entry in **List – I** to the correct entry in **List – II**.

	List – I	**List – II**	
(P)	If the temperature in terms of time is $T = 290 + \lambda e^{-kt}$, then λ is	(1)	40
(Q)	If the value of k is $\frac{\ln 2}{\lambda}$, then λ is	(2)	10
(R)	The time taken (in minutes) till temperature becomes 295K is	(3)	190

(S)	If $T = f(t)$, then value of $f\left(\frac{-2}{k}\right) = \lambda + \mu e^2$. The value of $\lambda - \mu$ is	(4)	80
		(5)	210

The correct option is

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

46. Let $A = \left[a_{ij}\right]_{3\times3}$ be a matrix such that $AA^T = 4I$ and $a_{ij} + 2c_{ij} = 0$, where c_{ij} is the cofactor of a_{ij} and I is the unit matrix of order 3. If

$$\begin{vmatrix} a_{11}+4 & a_{12} & a_{13} \\ a_{21} & a_{22}+4 & a_{23} \\ a_{31} & a_{32} & a_{33}+4 \end{vmatrix} + 5\lambda \begin{vmatrix} a_{11}+1 & a_{12} & a_{13} \\ a_{21} & a_{22}+1 & a_{23} \\ a_{31} & a_{32} & a_{33}+1 \end{vmatrix} = 0$$ then the value of 10λ is_____

47. If $2f(x) = f(xy) + f\left(\frac{x}{y}\right)$ for all positive values of x and y, $f(1) = 0$ and $f'(1) = 1$, then $f(e)$ is _____

48. If $\int \left(x^9 + x^6 + x^3\right)\left(2x^6 + 3x^3 + 6\right)^{1/3} dx = \frac{1}{A}\left(2x^9 + 3x^6 + 6x^3\right)^B + K$, then the value of $\frac{AB}{4}$ is

49. The papers of 4 students can be checked by any one of 7 teachers. If the probability that all the 4 papers are checked by exactly 2 teachers is A, then the value of 490 A must be

50. In a tetrahedron, the length of each edge is $\sqrt{2}$ .The shortest distance between a pair of opposite edges is

51. The eccentricity of an ellipse whose axes are the coordinate axes is $\frac{3}{5}$. If the length of its latus rectum is $\frac{32}{5}$, then the maximum distance of its centre from a normal is