

FIITJEE
ALL INDIA TEST SERIES
JEE (Advanced)-2023
FULL TEST – VII
PAPER –2
TEST DATE: 23-04-2023

Time Allotted: 3 Hours

Maximum Marks: 180

General Instructions:

- The test consists of total 54 questions.
- Each subject (PCM) has 18 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, 19 – 22, 37 – 40): This section contains **TWELVE (12)** questions. Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.

Section – A (05 –10, 23 – 28, 41 – 46): This section contains **EIGHTEEN (18)** questions. Each question has **FOUR** options. **ONE OR MORE THAN ONE** of these four option(s) is(are) correct answer(s).

Section – B (11 – 18, 29 – 36, 47 – 54): This section contains **TWENTY FOUR (24)** numerical based questions. The answer to each question is a **Single Digit Integer, ranging from 0 to 9 both inclusive**.

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	:	+3	If ONLY the correct integer is entered;
Zero Marks	:	0	Question is unanswered;
Negative Marks	:	-1	In all other cases.

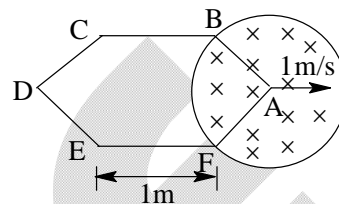
Physics

PART – I

Section – A (Maximum Marks: 12)

This section contains **FOUR (04)** questions. Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.

1. A cylindrical region of radius 1m has instantaneous homogenous magnetic field of 5T and it is increasing at a rate of 2T/s. A regular hexagonal loop ABCDEFA of side 1 m is being drawn into the region with a constant speed of 1 m/s as shown in the figure. What is the magnitude of emf developed in the loop just after the show instant when the corner A of the hexagon is coinciding with the centre of the circle?

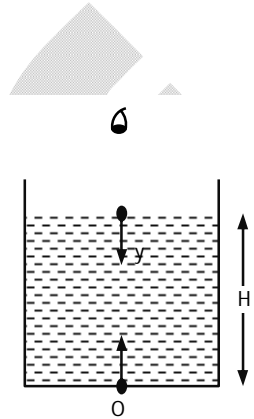


- (A) $5\sqrt{3}V$ (B) $2\pi/3V$
 (C) $(5\sqrt{3}+2\pi/3)V$ (D) $(5\sqrt{3}+\pi)V$
2. 101 tuning forks are arranged in order of increasing frequencies such that each fork gives 5 beats/sec with the next one. The first fork has a frequency three fourth of the last one. The frequency of the first fork is.
 (A) 500 Hz (B) 1000 Hz
 (C) 1500 Hz (D) 1750 Hz
3. If three rods placed along x, y and z axes are moving with velocities $V_0\hat{j}$, $V_0\hat{i}$ and $\frac{V_0}{2}\hat{i} + \frac{V_0}{2}\hat{j}$. The velocity of point of intersection of first two rods w.r.t. third rod is
 (A) $\frac{V_0}{2}\hat{i} + \frac{V_0}{2}\hat{j}$ (B) $\frac{V_0}{2}\hat{i} - \frac{V_0}{2}\hat{j}$
 (C) $-\frac{V_0}{2}\hat{i} - \frac{V_0}{2}\hat{j}$ (D) $V_0\hat{i} + \frac{V_0}{2}\hat{j}$
4. A cylinder with movable piston contains air under pressure P_0 and a soap bubble of radius r . The surface tension of the soap solution is T and the temperature of the system is kept constant. The pressure to which the air should be compressed by slowly pushing the piston into the cylinder for the soap bubble to reduce its size by half is:
 (A) $8\left[P_0 + \frac{3T}{r}\right]$ (B) $\left[P_0 + \frac{T}{r}\right]$
 (C) $8\left[P_0 + \frac{T}{r}\right]$ (D) $\left[P_0 + \frac{2T}{r}\right]$

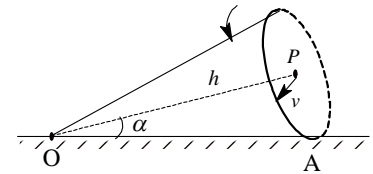
Section – A (Maximum Marks: 24)

This section contains **SIX (06)** 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).

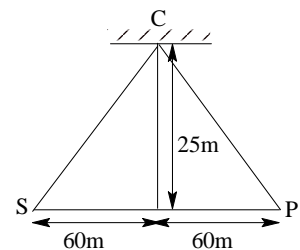
5. When water rises in a glass capillary then
 (A) water wet the glass.
 (B) force of adhesion is greater than force of cohesion.
 (C) force of adhesion is less than force of cohesion.
 (D) angle of contact is obtuse.
6. An insect starts moving up in a liquid from point O of variable refractive index $\mu = \mu_0(1 + ay)$, where y is depth of liquid from the surface. If u is speed of insect, then
 (A) its maximum apparent speed is $\frac{u}{\mu_0(1 + aH)}$
 (B) its maximum apparent speed is u/μ_0 .
 (C) its minimum apparent speed is $\frac{u}{\mu_0(1 + aH)}$
 (D) its minimum apparent speed is $\frac{u}{\mu_0(1 + aH)^2}$



7. A right circular cone of half-angle α which is hinged at point O and of height h rolls without slipping on a horizontal surface. If speed of the center of the base is v then which of the following statement is true?
 (A) the centre of the base moves in a circle with an angular speed $v/h \cos\alpha$.
 (B) the angular velocity of the cone has a magnitude $v/h \sin\alpha$.
 (C) the angular velocity of the cone is along the axis of symmetry of the cone.
 (D) the resultant angular velocity of cone is along line OA.



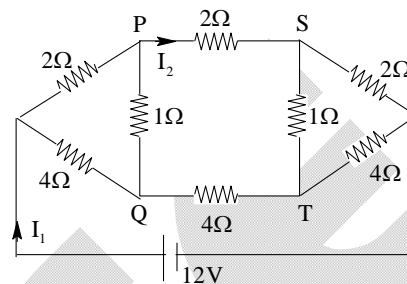
8. In a room a person receives direct sound waves from a source 120 m away from him. He also receives waves from the same source which reaches him, being reflected from the 25 m high ceiling at a point halfway between them. The wavelengths for which these waves interfere constructively are (assume no other way waves are reaching person)
 (A) 10 m
 (B) 5 m
 (C) 20 m
 (D) 20/3 m



9. When a person start walking without slipping on a horizontal rough surface. Then:
 (A) Friction acts in the direction of motion
 (B) Friction acts opposite to the direction of motion.
 (C) Work done by friction is equal to change in kinetic energy of person.
 (D) Work done by friction is zero.

10. For the circuit shown in the figure. Choose the correct option(s):

- (A) the current through PQ is zero
 (B) $I_1 = 3A$
 (C) the potential of Q is less than that of S
 (D) $I_2 = 2A$



Section – B (Maximum Marks: 24)

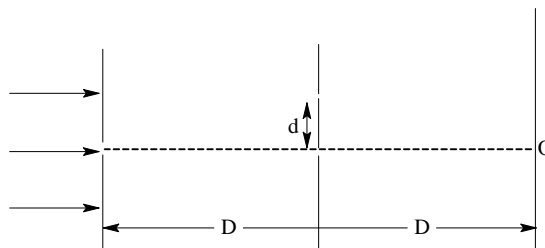
*This section contains **EIGHT (08)** numerical based questions. The answer to each question is a **Single Digit Integer, ranging from 0 to 9 both inclusive.***

11. In a series LCR AC circuit value of R, L and C are variable and numerical value of R is always equal to numerical value of L. for a given A.C. voltage source resonant current is obtained to be 2 A. Now capacitance of capacitor is increased to four times. Then new resonance current (in ampere) for the same source will be ____.

12. A vehicle moves along a curve $y = \frac{x^2}{2}$ with constant speed. Find the maximum speed (in m/s) with which it can move on the curve without slipping. (take coefficient of friction as $\frac{9}{10}$ and $g = 10 \text{ m/s}^2$).

13. A bullet is fired vertically upwards with velocity v from the surface of spherical planet. When it reaches it maximum height, its acceleration due to the planet's gravity is $\frac{1}{4}$ th of its value on the surface of the planet. If the escape velocity from the planet is $v_{esc} = v\sqrt{N}$, then the value of N is (ignore energy loss due to atmosphere).

14. Consider the arrangement shown in figure. The distance D is large compared to the separation d between the slits. If the minimum value of d so that there is a dark fringe at O is $\sqrt{D\lambda}/x$. Find the value of x.



15. A particle, of mass 10^{-3} kg and charge 1.0 C, is initially at rest. At time $t = 0$, the particle comes under the influence of an electric field $\vec{E}(t) = E_0 \sin \omega t \hat{i}$, where $E_0 = 1.0 \text{ NC}^{-1}$ and $\omega = 10^3 \text{ rads}^{-1}$. Consider the effect of only the electrical force on the particle. Then find the maximum speed, in m s^{-1} , attained by the particle at subsequent times.
16. A galvanometer gives full scale deflection with 0.006A current. By connecting it to a 4990 Ω resistance, it can be converted into a voltmeter of range 0 – 30 V. If connected to a $\frac{2n}{249} \Omega$ resistance, it becomes an ammeter of range 0 -1.5A . The value of n is:
17. A proton is fired from very far away towards a nucleus with charge $Q = 120e$, where e is the electronic charge. It makes a closed approach of 10fm to the nucleus. The de Broglie wavelength (in units of fm) of the proton at the start is: (take the proton mass, $m_p = (5/3) \times 10^{-27}$ kg; $h/e = 4.2 \times 10^{-15}$ Js/C; $1/4\pi\epsilon_0 = 9 \times 10^9 \text{ m/F}$; $1\text{fm} = 10^{-15}\text{m}$)
18. A hot body is suspended inside a room that is maintained at a constant temperature. The temperature difference between the body and the surrounding becomes half in a time interval of 3 minutes. In how much time (in minutes) the temperature difference between the body and the surrounding will becomes $1/4^{\text{th}}$ the original value? (Assume newton's law of cooling is valid).

Chemistry

PART – II

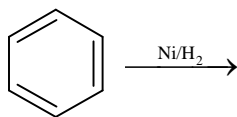
Section – A (Maximum Marks: 12)

This section contains **FOUR (04)** questions. Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.

19. What is the percent by mass of titanium in rutile, a mineral that contains titanium and oxygen, if its structure can be described as a closest array of oxide ions at FCC, with titanium in one half of the octahedral holes. What is the oxidation number of titanium? (Atomic Weight of Ti=48)

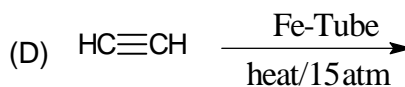
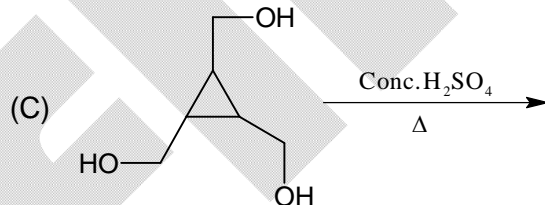
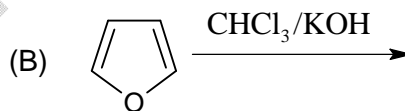
- (A) $\approx 50\%$, +4
 (B) $\approx 60\%$, +2
 (C) $\approx 60\%$, +4
 (D) $\approx 30\%$, +2

20. The product which can be best isolated from this reaction given below will be:

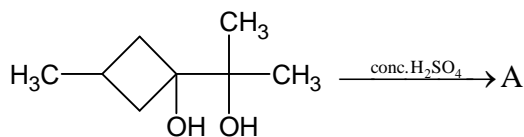


- (A) (B)
 (C) (D) Mixture of (A), (B) and (C)

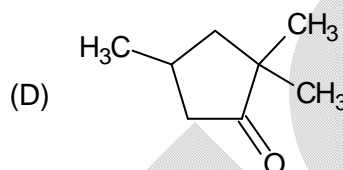
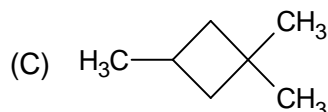
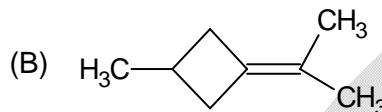
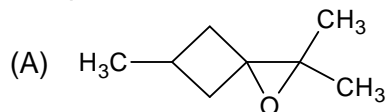
21. Which among the following change cannot give six membered aromatic substance as one of the products.



22. In the reaction



The product A is:



Section – A (Maximum Marks: 24)

This section contains **SIX (06)** 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).

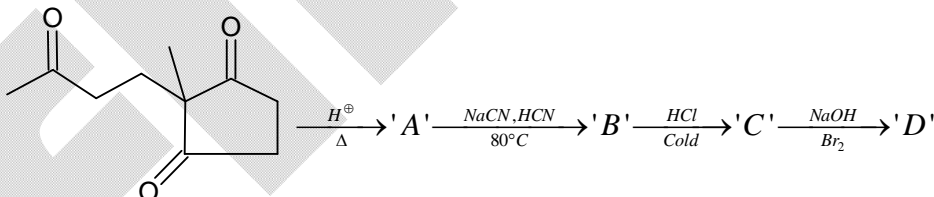
23. The correct statement(s) about the surface properties is (are):

- (A) Soap lather is colloidal solution in which gas is dispersed in liquid.
- (B) The surface coverage increases on increasing the pressure for chemisorption and the surface coverage is higher for undissociative process than the dissociative process (e.g. H_2 to 2H) under identical constant.
- (C) On increasing the concentration of cationic surfactant, surface tension decreases before CMC.
- (D) CMC for non-ionic surfactant is higher than anionic surfactant.

24. NiO (Green) is doped with colorless Li_2O , to give black solid $\text{Li}_x\text{Ni}_{1-x}\text{O}$ which acts as semiconductor:

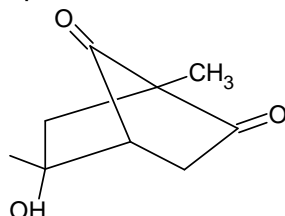
- (A) $\text{Li}_x\text{Ni}_{1-x}\text{O}$ exhibit both cationic and anionic vacancies
- (B) $\text{Li}_x\text{Ni}_{1-x}\text{O}$ exhibit Schottky defect
- (C) Doping of NiO with Li_2O induces mixed valency of Ni
- (D) NiO becomes p-type semiconductor

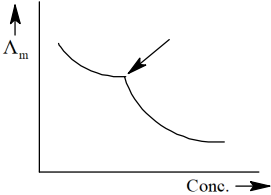
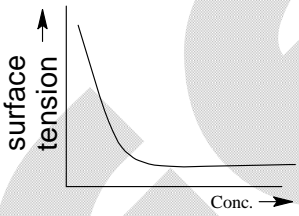
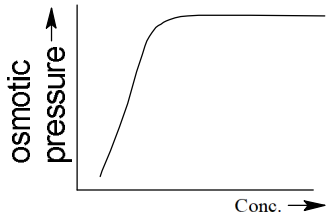
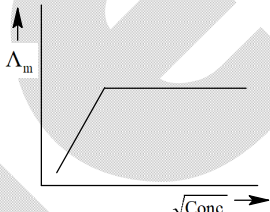
25.



- (A) Compound 'D' gives positive iodoform test
- (B) Compound 'D' gives positive carbylamines test
- (C) Compound 'C' gives positive 2, 4-DNP test
- (D)

Compound 'A' is



26. The correct option(s) is /are:
 (A) $F-F < Cl-Cl < Br-Br < I-I$ (Bond length)
 (B) Bond angle of $F_{eq.} - S - F_{eq.}$ bond is less in CH_2SF_4 than SOF_4
 (C) $H_2S < O_3 < SO_2 < NO_2$ (Bond angle)
 (D) $AsH_3 < SbH_3 < NH_3 < H_2O$ (boiling point)
27. Molar conductivity Λ_m of an aqueous solution of sodium dodecylsulphate, which behaves as a strong electrolyte which of the following plots provides the correct representation of micelle formation in aqueous solution. (CMC is marked as arrows)
- (A) 
- (B) 
- (C) 
- (D) 
28. The correct statements about some of the ions of 3d-series in aqueous solution
 (A) Cr^{2+} is better reducing agent than Fe^{3+}
 (B) Co^{3+} is better oxidising agent than Fe^{3+} .
 (C) When Fe^{3+} is used as oxidising agent, it attains $3d^7$ electronic configuration
 (D) Cu is the only metal in 3d series, which is not having ability to displace hydrogen as H_2 from acid (consider thermodynamic aspect).

Section – B (Maximum Marks: 24)

This section contains **EIGHT (08)** numerical based questions. The answer to each question is a **Single Digit Integer, ranging from 0 to 9 both inclusive**.

29. When Al pieces are added to aqueous solution of tetrathionic acid ($H_2S_4O_6$) a pungent gas (rotten egg smell) is produced. Find the number of moles of aluminium consumed per mole of tetrathionic acid in the reaction:
30. In which of the following compounds bridging bonds & terminal bonds are lying in same plane?
 Be_2H_4 , Be_2Cl_4 , I_2Cl_6 , Al_2Cl_6 , Fe_2Cl_4 , Al_2H_6 , $Al_2(NH_2)_6$, $Al_2(OH)_6$
31. Consider the complete hydrolysis of following compounds
 Marshall's Acid + $xH_2O \xrightarrow{\text{complete hydrolysis}}$
 Xenon oxy tetrafluoride + $yH_2O \xrightarrow{\text{complete hydrolysis}}$
 Calculate $(x + y)$

32. $\text{SrOCl}_2 \xrightarrow{\Delta} a \text{Sr}(\text{ClO}_3)_2 + b \text{SrCl}_2$
 $\text{NaCl} + \text{H}_2\text{SO}_4 \longrightarrow \text{Na}_2\text{SO}_4 + c \text{HCl}$
 $\text{Na}_2\text{S}_2\text{O}_3 + d \text{HCl} \longrightarrow e \text{NaCl} + \text{H}_2\text{O} + \text{S} \downarrow + \text{SO}_2$
 The value of $a + b - d - e$
33. In how many cases $\Delta S_{\text{system}} > 0$
- Reversible melting of solid benzene at 1 atm & at the normal melting point.
 - Reversible melting of ice at 1 atm 0°C
 - Reversible adiabatic expansion of ideal gas
 - Reversible isothermal expansion of ideal gas
 - adiabatic expansion of perfect gas in vacuum
 - Reversible heating of perfect gas at constant P.
 - Reversible cooling of perfect gas at constant V.
 - Adiabatic expansion of non-ideal gas in to vacuum.
 - Mixing of some ideal gas in an isolated container.
34. The volume of $\text{N}_2(\text{g})$ at STP (P=1 atm) would be liberated from $\frac{1}{22.4}$ mole of proline by treatment with HNO_2 _____.
35. Horse hemoglobin contains 0.335% Fe. Osmotic pressure measurement gives a molecular weight of about 50148. How many Fe atoms are present in one molecule of hemoglobin _____.
 (Atomic weight of Fe=56)
36. Salicylaldehyde + acetophenone $\xrightarrow{\text{OH (aldol reaction)}} \text{L}$
 $\text{L} + \text{HCl} \longrightarrow \text{salt of chloride (M)} [\text{C}_{15}\text{H}_{11}\text{OCl}]$
 The number of aromatic rings in M _____.

Mathematics

PART – III

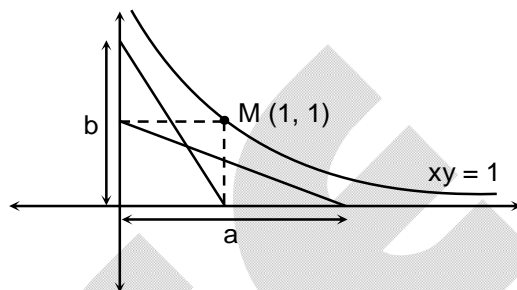
Section – A (Maximum Marks: 12)

This section contains **FOUR (04)** questions. Each question has **FOUR** options. **ONLY ONE** of these four options is the correct answer.

37. With reference to the graph shown then the value of $\tan^{-1} a + \tan^{-1} b - \tan^{-1} \left(\frac{a+b}{1-ab} \right)$ is

equal to

- (A) 0
- (B) $-\pi$
- (C) π
- (D) does not exist



38. If $f : \mathbb{R} \rightarrow \mathbb{R}$ be a differentiable function such that $(f(x))^7 = x - f(x)$ then the area bounded by curve $y = f(x)$ between the ordinates $x = 0$ and $x = \sqrt{3}$ is

(A) $\frac{f(\sqrt{3})}{8} [8\sqrt{3} - (f(\sqrt{3}))^7 - 4f(\sqrt{3})]$ sq. units

(B) $\frac{f(\sqrt{3})}{4} [8\sqrt{3} - (f(\sqrt{3}))^7]$ sq. units

(C) $\left(\sqrt{3}f(\sqrt{3}) - \frac{93}{8} \right)$ sq. units

(D) $\frac{f(\sqrt{3})}{8} [4\sqrt{3} - (f(\sqrt{3}))^8 - 4f(\sqrt{3})]$ sq. units

39. The value of integer $\int_{-1}^1 \frac{dx}{(x^2 + x + 1) + \sqrt{x^4 + 3x^2 + 1}}$ is

(A) $\frac{1}{2\sqrt{2}}$

(B) 0

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

(D) $\frac{\pi}{4}$

40. Suppose, $n > 4$ such that coefficient of x^{n-4} and xy are same in the expansion of

$(x + 2\sqrt{y} - 1)^n$, then n is equal to _____

(A) 4

(B) 50

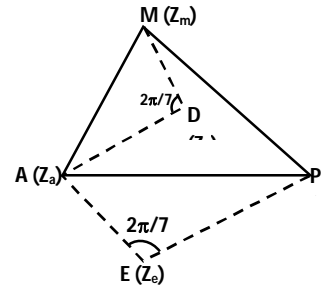
(C) 51

(D) 54

Section – A (Maximum Marks: 24)

This section contains **SIX (06)** 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).

41. In a $\triangle MAP$, on sides MA and AP regular heptagons are drawn; if P and D are on the same side of AM and M, E are on opposite sides of AP, where D and E are centres of the heptagons MA and AP respectively then angle between MP and DE is



- (A) $\frac{15\pi}{23}$ (B) $\frac{5\pi}{14}$
 (C) $\frac{9\pi}{14}$ (D) $\frac{8\pi}{23}$

42. $I_n = \int_{\frac{n}{2}}^{\frac{n+1}{2}} \frac{\sin(\pi \sin^2 \pi x)}{(\sqrt{2})^x} dx, n \in \mathbb{I}$

- (A) $\frac{I_n}{I_{n+4}} = 2$ (B) $\frac{I_n}{I_{n+4}} = \frac{1}{\sqrt{2}}$
 (C) $\frac{\sum_{n=0}^{\infty} I_{8n}}{I_0} = \frac{4}{3}$ (D) $\frac{\sum_{n=0}^{\infty} I_n}{I_0} = 2$

43. Consider $A = \cos(\sin \pi x), B = \sin(\cos \pi x), C = \cos \pi(x + 1) \forall x \in \left(-\frac{1}{2}, 0\right)$, then

- (A) $B > C$ (B) $A > B$
 (C) $A < B < 0$ (D) $C < 0$

44. For $f(x) = \sin x$, suppose $a \in \mathbb{R}^+$ such that maximum value of $f(x)$ in $[0, a]$ is twice the maximum value of $f(x)$ in $[a, 2a]$ then a can be

- (A) $5\pi/6$ (B) $\pi/6$
 (C) $13\pi/12$ (D) $7\pi/6$

45. Suppose $f(x) = \begin{cases} |\log_3 x - 1|, & 0 < x \leq 9 \\ (4 - \sqrt{x}), & x > 9 \end{cases}$ defined on positive set of Real number; provided that

$a, b, c \in \mathbb{R}$ which are not equal to each other satisfying $f(a) = f(b) = f(c)$ then abc can be

- (A) 81 (B) 85
 (C) 88 (D) 143

46. Let A and B are two non-singular matrices of order 3 with real entries such that $\text{adj}(A) = 2B$ and $\text{adj}(B) = A$, then (where $|A| = \det A$)

- (A) $|A| + |B| = 6$ (B) $|A| + |B| = -6$
 (C) $\text{adj}(A^2B) + \text{adj}(AB^2) = 4(A + 2B)$ (D) $\text{adj}(A^2B) + \text{adj}(AB^2) = 4(2A + B)$

Section – B (Maximum Marks: 24)

This section contains **EIGHT (08)** numerical based questions. The answer to each question is a **Single Digit Integer, ranging from 0 to 9 both inclusive**.

47. Suppose there exists a point (x_0, y_0) on the circle $(x - r - 1)^2 + y^2 = r^2$ satisfying $4x_0 - y_0^2 \leq 0$ then the minimum value of $|r|$ is _____
48. Assuming all the terms of A.P $[a_n]$ are integers with $a_1 = 2019$ and for $n \in \mathbb{I}^+$ there always exists positive integer m such that $a_1 + a_2 + a_3 + \dots + a_{n-2} + a_{n-1} + a_n = a_m$, then find number of such sequences _____
49. $f(x)$ is a continuous increasing function with $f(x) \geq x$ and $(h) = (1 - x)^{-1}$ then number of integral values in Real Numbers not belonging to the domain of $\phi(x) = (f^{2022}(x) - h^{2025}(x))^{1/2024}$ where $f^n(x) = f \circ f \dots$ of n times is /are _____
50. The volume of tetrahedron AKHI is $1/6$ unit³, $\angle KIH = \pi/4$ and $\sqrt{2}(AK + HI) + KI = 3\sqrt{2}$, $AK = 1$, then $\sqrt{3} AI$ is equal to _____
51. Consider $f: \mathbb{R}^+ \rightarrow \mathbb{R}$ such that $f(x) = 1$ for $a \in \mathbb{R}^+$ and $f(x)f(y) + f\left(\frac{3}{x}\right)f\left(\frac{3}{y}\right) = 2f(xy) \forall x, y \in \mathbb{R}^+$ then. Find $f(99)$.
52. Suppose A be a set of first 5 natural numbers. Identifying X, Y as non-equal, non-empty subsets of A then number of ordered set pairs of (X, Y) such that $\max(X) > \min(Y)$ is 2^p then p is equal to _____
53. If the interval of a for which $a^x = \log_a x$ has exactly 3 solution is $(0, b^{-b})$ then $[b]$ _____ where $[\cdot]$ G.I.F.
54. The value of $\left[\pi \cdot \frac{2}{1} \cdot \frac{2}{3} \cdot \frac{4}{3} \cdot \frac{4}{5} \cdot \frac{6}{5} \cdot \frac{6}{7} \cdot \frac{8}{7} \cdot \frac{8}{9} \dots \infty \right]$ is _____. Where $[\cdot]$ G.I.F.