

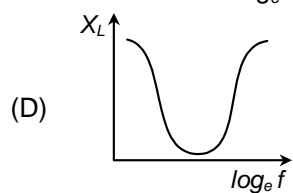
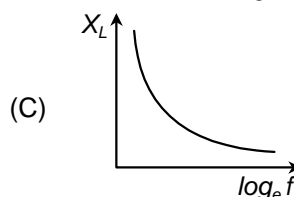
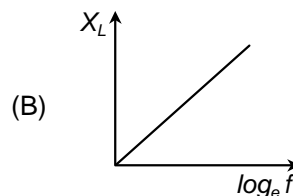
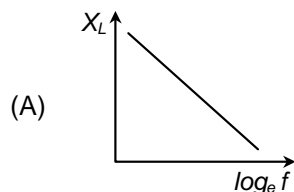
Physics

PART – I

SECTION – A (One Options Correct Type)

This section contains **3 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

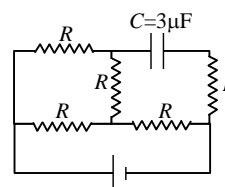
1. The correct curve between X_L and $\log_e f$ is



2. In the given circuit, the potential difference across the capacitor is 12 V in steady state. Each resistor have 3Ω resistance. The emf of the ideal battery is

(A) 15 V
(C) 12 V

(B) 9 V
(D) 24 V



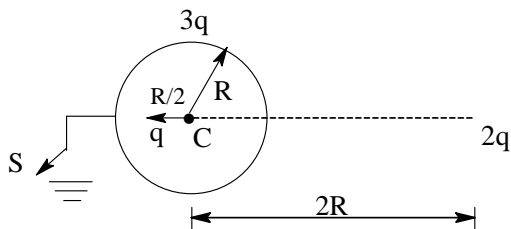
3. A current of (2.5 ± 0.05) A flows through a wire and develops a potential difference of (10 ± 0.1) volt. Resistance of the wire in ohm, is
- (A) 4 ± 0.12
(C) 4 ± 0.08
- (B) 4 ± 0.04
(D) 4 ± 0.02

Space for Rough work

(One or More than one correct type)

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

4. Two identical spheres S_1 and S_2 , out of which S_1 is placed on the insulating horizontal surface and S_2 hangs from an insulating string. If both were given same quantity of heat. Then:
 (A) temperature of S_1 will increase more than S_2
 (B) temperature of S_2 will increase more than S_1
 (C) Heat given only increases internal energy
 (D) Heat given not only increases internal energy but goes in other forms also.
5. A spherical shell of radius R is given charge $3q$ on its surface and a point charge q is placed at distance $R/2$ from its centre C . Also there is a charge $2q$ placed outside the shell at a distance of $2R$ as shown. Then



- (A) The magnitude of electric field at the centre C due to charges on the outer surface of shell is $\frac{Kq}{2R^2}$ before closing the switch S .
- (B) The electric potential at the centre C due to charges on the outer surface of shell is $\left(\frac{-Kq}{R}\right)$ before closing the switch S .
- (C) The electric potential at the centre C due to charges on the outer surface of shell is $\left(\frac{-Kq}{R}\right)$ after closing the switch S .
- (D) Charge flown through the switch in to earth after closing the switch S is $5q$

Space for Rough work

6. The natural length of a metallic rod at 0°C is l_1 , at $\theta^\circ\text{C}$ is l_2 . The given lengths of the rod at θ° is l_3 , then:
- (A) The thermal stress in the rod is non zero if $l_3 > l_2$
 (B) The strain in the rod is zero if $l_2 \neq l_3$
 (C) The thermal stress in the rod is non-zero if $l_3 < l_2$
 (D) The thermal stress and strain will be zero if $l_2 = l_3$
7. Which of the following is/are correct?
- (A) If centre of mass of three particles is at rest and it is known that two of them are moving along different lines then the third particle must also be moving.
 (B) If centre of mass remains at rest then the net work done by the forces acting on the system must be zero.
 (C) If the centre of mass remains at rest then the net external force must be zero.
 (D) If the velocity of the centre of mass is changing then there must be some net work being done on the system.
8. A spring balance reads W_1 when a ball is suspended from it. A weighing machine reads W_2 when a tank of liquid is kept on it. When the ball is immersed in the liquid, the spring balance reads W_3 and the weighing machine reads W_4
- (A) $W_1 > W_3$ (B) $W_1 < W_3$
 (C) $W_2 < W_4$ (D) $W_2 > W_4$

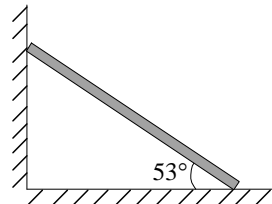
Space for Rough work

(Paragraph Type)

This section contains **ONE** paragraph. Based on the paragraph, there are **TWO** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.

Paragraph for Question Nos. 9 and 10

A rod of length 10 meter has one end on smooth floor and the other end on smooth wall is released from the rest from the position shown in figure. When the rod makes an angle of 37° with the horizontal, answer the following:



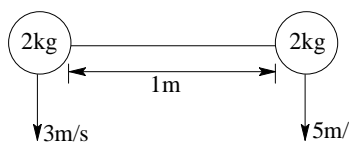
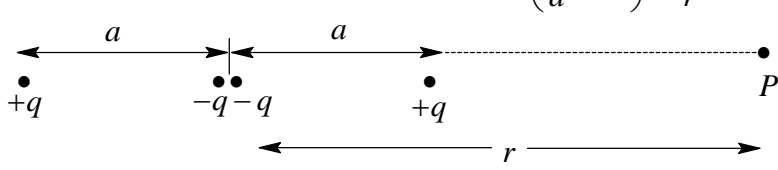
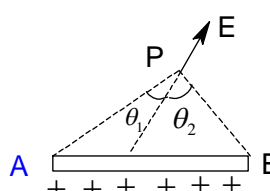
9. The angular velocity of rod is:
- (A) $\sqrt{3}$ rad/sec (B) $\sqrt{5}$ rad/sec
- (C) $\sqrt{\frac{5}{3}}$ rad/sec (D) $\sqrt{\frac{3}{5}}$ rad/sec
10. The velocity of centre of mass of rod is:
- (A) $\sqrt{5}$ m/s (B) $\sqrt{10}$ m/s
- (C) $\sqrt{15}$ m/s (D) $\sqrt{20}$ m/s

SECTION – C
(Single digit integer type)

This section contains **TEN** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

11. For a given velocity of projection from a point on the inclined plane, the maximum range down the plane is three times the maximum range up the incline. The angle of inclination of incline plane is $K \times 10$ [in degrees].
12. In L-R circuit, the A.C. source has voltage 220V. If potential difference across inductor is 176V, the potential difference across the resistor (in Volts) is $K \times 33$. Find the value of K

Space for Rough work

13. Two particles are performing SHM with same amplitude and time period. At an instant two particles are having velocity 1 m/s but one is on the right and the other is on the left of their mean position. When the particles have same position there speed is $\sqrt{3}$ m/s. Find the maximum speed (in m/s) of particles during SHM.
14. A small ball is kept on the top of a sphere of radius R. The sphere start accelerating with constant acceleration of 10 m/s^2 horizontally. The angle of radial line with the vertical at which small ball leaves the sphere is $\frac{1}{2} \sin^{-1}(K/9)$. Find the value of K. [take $g = 10 \text{ m/s}^2$]
15. Two balls of masses are connected with a massless rod of length 1 meter and are given velocities on a horizontal surface parallel to surface as shown in the figure. Then the tension in the rod at the given instant is:
- 
16. Figure shows a charge array known as an “electric quadrupole”. For a point on the axis of the quadrupole, the dependence of potential on r ($\frac{r}{a} \gg 1$) is $\frac{1}{r^n}$. Find n ?
- 
17. The net electric field \vec{E} due to the uniformly charged rod at P makes angles θ_1 and θ_2 with AP and BP respectively. Then find the value of θ_1 / θ_2 .
- 
18. A point object is placed at a distance 25 cm from a convex lens of focal length 22 cm . If a glass slab of refractive index 1.5 is inserted between the lens and object, then the image is formed at infinity. Find the thickness of glass slab (in cm.)

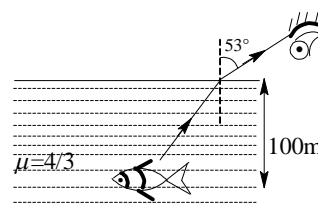
Space for Rough work

19. Two radioactive materials X_1 and X_2 have decay constants 10λ and λ respectively. If initially they have the same number of nuclei, if the ratio of the number of nuclei of X_1 to that of X_2 will be $1/e$ after a time $\frac{n}{9\lambda}$. Find the value of n ?
20. Two wires are made of the same material and have the same volume. However, wire 1 has cross-sectional area A and wire-2 has cross-sectional area $3A$. If the length of wire 1 increases by Δx on applying force 1 newton, how much force is needed to stretch wire 2 by the same amount?

SECTION – D
(Numerical Based XXXXX.XX answer Type)

This section contains **3 questions**. Each question, when worked out will result in numerical answer Type with answer xxxxx.xx.

21. Find the apparent depth of a fish (in meter) whose real depth is 100m and is observed at an angle of vision 53° as shown in the figure



22. In a resonance column experiment the frequency of tuning fork used is 1000 Hz and the length of pipe is 100m. Ignoring end correction find the length (in cm) of air column at which second resonance is observed. [Take speed of sound = 330 m/s]
23. Find the minimum kinetic energy (in joule) with which a particle of mass 2kg should be projected from ground so that it crosses a cylindrical drum (placed on ground) of radius 1 meter and fall on the other side following a parabolic path. [Take $g = 10 \text{ m/s}^2$ and $\sqrt{2} = 1.414$]

Space for Rough work

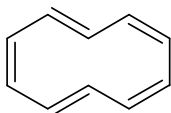
Chemistry

PART – II

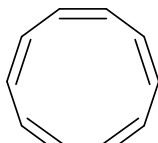
SECTION – A (One Options Correct Type)

This section contains **3 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

24. The following two compound are:



(I)



(II)

- (A) Identical isomers
(B) conformational isomers
(C) geometrical isomers
(D) Optical isomers
25. If mercuric iodide is added to an aqueous solution of KI, the:
(A) freezing point increased
(B) freezing point is lowered
(C) boiling point does not change
(D) Osmotic pressure increased
26. Which of the following is weaker base?
(A) $N(SiH_3)_3$
(B) $N(CH_3)_3$
(C) $NH(CH_3)_3$
(D) All are equally basic

(One or More than one correct type)

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

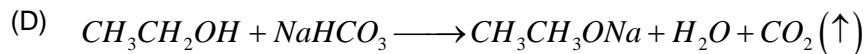
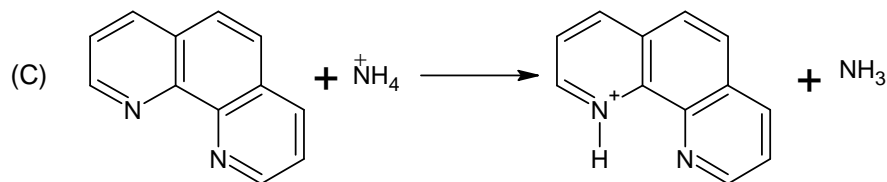
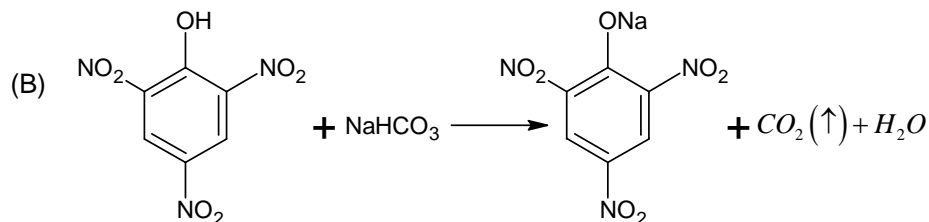
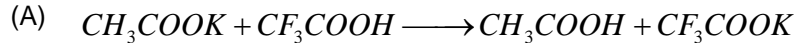
27. Choose the incorrect methods for each:
(A) Ni : electrolysis process, Cu : van Arkel process, Zn : zone refining, Ga : zone refining
(B) Ni : mond's process, Cu : electrolysis, Zr : van Arkel process, Ga : zone refining
(C) Ni : electrolysis process, Cu : zone refining, Zr : van Arkel process, Ga : electrolysis
(D) Ni : electrolysis process, Cu : zone refining, Zr : van Arkel process, Ga : mond's process

Space for Rough work

28. Which of the following have transition metal?

- (A) Haemoglobin (B) Vitamin B_{12}
(C) Cis – platin (D) Chlorophyll

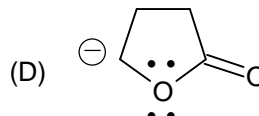
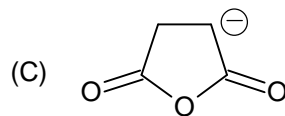
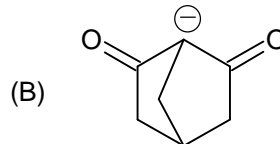
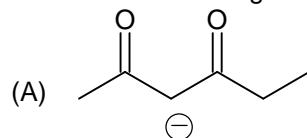
29. Which one of the following reactions is/are correct?



30. Which of the following is/are the compound of aluminium?

- (A) horn silver (B) bauxite
(C) corundum (D) Diaspore

31. Which of the following carbanions are not resonance stabilized?



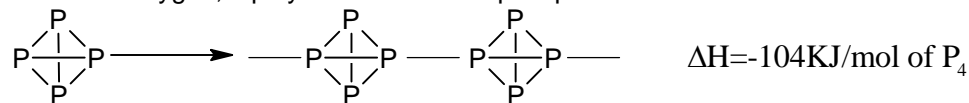
Space for Rough work

(Paragraph Type)

This section contains **ONE** paragraph. Based on the paragraph, there are **TWO** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.

Paragraph for Question Nos. 32 and 33

White phosphorus is a tetra atomic solid $[P_4(s)]$ at room temperature and on strong heating in absence of oxygen, it polymerizes into red phosphorus as:



White(g)

red(g)

The enthalpy of sublimation $[P_4(s) \longrightarrow P_4(g)]$ white is 59 KJ/mol and enthalpy of atomization is 316.25 KJ/mol of $P(g)$.

Now give the answers of following questions:

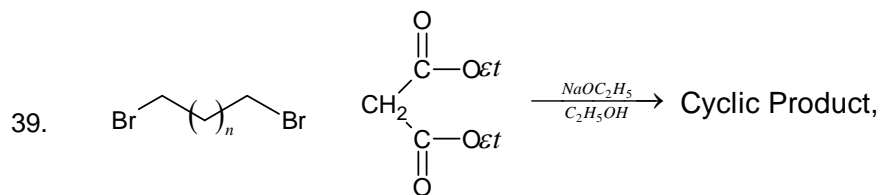
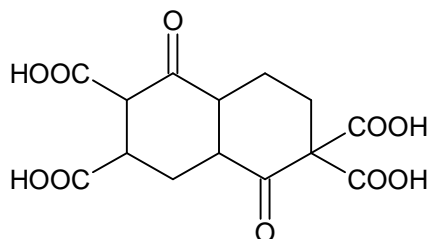
32. The average $P - P$ bond enthalpy in P_4 molecule is:
 (A) 102 KJ (B) 201 KJ
 (C) 104 KJ (D) 120 KJ
33. The $P - P$ bond enthalpy in red phosphorus joining the two tetrahedral is:
 (A) 201 KJ (B) 104 KJ
 (C) 305 KJ (D) 80 KJ

Space for Rough work

SECTION – C
(Single digit integer type)

This section contains **TEN** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

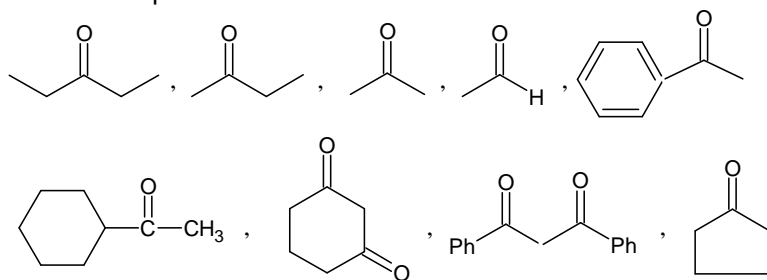
34. An orbital has only positive values of wave function at all distances from the nucleus. Find the value of $(n + l)$ for this orbital.
35. Isotopic number of $^{58}_{26}\text{Fe}$ is:
36. The Henry's law constant for the solubility of N_2 gas in water at 298 K is $1 \times 10^5 \text{ atm}$. The mole fraction of N_2 air is 0.8. The number of mole of N_2 of dissolved in 10 mole of water at 298 K and 5 atm . are $x \times 10^{-4}$. Find the value of x .
37. The mass of a non-volatile solute (Molar mass 40) which should be dissolved in 114 g octane to reduce its vapour pressure to 80 % is $2x \text{ g}$. Find the value of x
38. How many moles of CO_2 will released when following compound is heated



At what value of ' n ' the formation of six membered ring take place.

Space for Rough work

40. Examine the structural formulas of compounds given below and identify number of compounds which show positive iodoform test.



41. Calculate the value $X - Y$, for $XeOF_4$. (X=Number of σ bond pair and Y=Number of lone pair on central atom).
42. For oxyacid $HClO_x$, if $x = y = z$ (x, y and z are natural numbers), then calculate the value of $|x + y + z|$. Where x = Number of 'O' atoms.
 y = Total number of lone pairs at central atom
 z = Total number of π electrons in the oxyacid
43. The number of electrons for Zn^{2+} cation that have the value of azimuthal quantum number = 0 is:

Space for Rough work

SECTION – D
(Numerical Based XXXXX.XX answer Type)

This section contains **3 questions**. Each question, when worked out will result in numerical answer Type with answer xxxxx.xx.

44. One mole of nitrogen gas at 0.8 atm takes 38 seconds to diffuse through a pinhole, whereas one mole of a compound of xenon with fluorine at 1.6 atm takes 57 seconds to diffuse through the same hole. Calculate molecular weight of the compound.
45. Calculate $\Delta_f H^\circ$ (magnitude only) for chloride ion (aq.) from the following data:
- $$\frac{1}{2} H_2(g) + \frac{1}{2} Cl_2(g) \rightarrow HCl(g); \quad \Delta_f H^\circ = -92.4 kJ$$
- $$HCl(g) + H_2O(l) \rightarrow H_3O^+(aq) + Cl^-(aq); \quad \Delta H^\circ = -74.8 kJ$$
- $$\Delta_f H^\circ \text{ of } H^+(aq) = 0.0 kJ$$
46. K_{sp} of $PbBr_2$ (Molar mass = 367) is 3.2×10^{-5} . If the salt is 80% dissociated in solution, calculate the solubility of salt in g per litre.

Space for Rough work

Mathematics

PART – III

SECTION – A (One Options Correct Type)

This section contains **3 multiple choice questions**. Each question has **four choices** (A), (B), (C) and (D), out of which **ONLY ONE** option is correct.

47. Maximum value of function $f(x) = (\sin^{-1}(\sin x))^2 - \sin^{-1}(\sin x)$ is:
- (A) $\frac{\pi}{4}(\pi + 2)$ (B) $\frac{\pi}{4}(\pi - 2)$
 (C) $\frac{\pi}{4}$ (D) None of these
48. For a parabola $x^2 - 4xy + 4y^2 - 32x + 4y + 16 = 0$, focus is:
- (A) (2,1) (B) (-2,1)
 (C) (-2,-1) (D) (2,-1)
49. Let $f(x) = ax^4 + bx^2 + 3x + 7$ and $f(-4) = 2286$ and $f(4) = N$. The number of ways in which N can be resolved as a product of two divisors which are relatively prime:
- (A) 15 (B) 16
 (C) 17 (D) None of these

Space for Rough work

(One or More than one correct type)

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

50. The volume of a right triangular prism $ABCA_1B_1C_1$ is equal to 3. If the position vectors of the vertices of the base ABC are $A(1, 0, 1)$; $B(2, 0, 0)$ and $C(0, 1, 0)$ the position vectors of the vertex A_1 can be:
 (A) $(2, 2, 2)$ (B) $(0, 2, 0)$
 (C) $(0, -2, 2)$ (D) $(0, -2, 0)$
51. If the equation $|z|(z+1)^8 = z^8|z+1|$ where $z \in \mathbb{C}$ and $z(z+1) \neq 0$ has distinct roots $z_1, z_2, z_3, \dots, z_n$ (where $n \in \mathbb{N}$) then which of the following is/are true?
 (A) $z_1, z_2, z_3, \dots, z_n$ are concyclic points (B) $z_1, z_2, z_3, \dots, z_n$ are collinear points
 (C) $\sum_{r=1}^n \operatorname{Re}(z_r) = \frac{-7}{2}$ (D) $\sum_{r=1}^n \operatorname{Im}(z_r) = 0$
52. If in a $\triangle ABC$, a, b, c are in A.P. and P_1, P_2, P_3 are the altitudes from the vertices A, B and C respectively, then
 (A) P_1, P_2, P_3 are in A.P. (B) P_1, P_2, P_3 are in H.P.
 (C) $P_1 + P_2 + P_3 \leq \frac{3R}{\Delta}$ (D) $\frac{1}{P_1} + \frac{1}{P_2} + \frac{1}{P_3} \leq \frac{3R}{\Delta}$
53. Suppose a_1, a_2, a_3 are in A.P. and b_1, b_2, b_3 are in H.P. and let $\Delta = \begin{vmatrix} a_1 - b_1 & a_1 - b_2 & a_1 - b_3 \\ a_2 - b_1 & a_2 - b_2 & a_2 - b_3 \\ a_3 - b_1 & a_3 - b_2 & a_3 - b_3 \end{vmatrix}$,
 then
 (A) Δ is independent of $a_1, a_2, a_3, b_1, b_2, b_3$
 (B) $a_1 - \Delta, a_2 - 2\Delta, a_3 - 3\Delta$ are in A.P.
 (C) $b_1 + \Delta, b_2 + \Delta^2, b_3 + \Delta$ are in H.P.
 (D) none of these

Space for Rough work

54. Given three non – zero, non – coplanar vectors, and \vec{a}, \vec{b} and \vec{c} and $\vec{r}_1 = p\vec{a} + q\vec{b} + \vec{c}$ and $\vec{r}_2 = \vec{a} + p\vec{b} + q\vec{c}$ if the vectors $\vec{r}_1 + 2\vec{r}_2$ and $2\vec{r}_1 + \vec{r}_2$ are collinear then (p, q) is
- (A) (0, 0) (B) (1, -1)
(C) (-1, 1) (D) (1, 1)

(Paragraph Type)

This section contains **ONE** paragraph. Based on the paragraph, there are **TWO** questions. Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.

Paragraph for Question Nos. 55 and 56

Let t be a real number satisfying $2t^3 - 9t^2 + 30 - \lambda = 0$ where $t = x + \frac{1}{x}$ and $\lambda \in \mathbb{R}$ then

55. If the cubic equation has three real and distinct solution for x then λ
- (A) Is greater than 9 (B) Is greater than 11
(C) Is less than 8 (D) Is not equal to 10
56. If the cubic equation has exactly two real and distinct roots of x then exhaustive set of values of λ is
- (A) $\lambda \in (-\infty, 3) \cup (30, \infty)$ (B) $\lambda \in (-\infty, -22) \cup (10, \infty) \cup \{3\}$
(C) $\lambda \in \{3, 30\}$ (D) None of these

SECTION – C
(Single digit integer type)

This section contains **TEN** questions. The answer to each question is a single Digit integer ranging from 0 to 9, both inclusive.

57. Consider on equation with x as variable $7\sin 3x - 2\sin 9x = \sec^2 \theta + 4\operatorname{cosec}^2 \theta$ then the value of $\frac{15}{2\pi}$ [minimum positive root – maximum negative root] is:

Space for Rough work

58. Let $P(x) = Q_0 + a_1x + a_2x^2 + \dots + a_nx^n$ be a non zero polynomial with integer coefficients. If one of the root is $\sqrt{2} + \sqrt{3} + \sqrt{6}$ then the smallest possible value of n is
59. $f(x) = \max|2\sin y - x|$ where $y \in \mathbb{R}$ then minimum value of $f(x)$ is:
60. Let $f(x) (x > 1)$ be a differentiable function satisfying $f(x) = (\ln x)^2 - \int_1^x \frac{f(t)}{t} dt$. Then if Area bounded by tangent line of $y = f(x)$ at $(e, f(e))$, then curve $y = f(x)$ and $x = 1$ is A then $[A]$ is $([.]$ is G. I. F)
61. If the area enclosed by $g(x)$, $x = -3$, $x = 5$ and x -axis where $g(x)$ is the inverse of $f(x) = x^3 + 3x + 1$ is A , then $[A]$ is $([.]$ is G. I. F)
62. Let $f(x) = \cos 2x \cdot \cos 4x \cdot \cos 6x \cdot \cos 8x \cdot \cos 10x$ then $\lim_{x \rightarrow 0} \frac{1 - (f(x))^3}{55 \sin^2 x}$ equals
63. Number of values of $x \in [0, \pi]$ where $f(x) = [4 \sin x - 7]$ is non derivable is $([.]$ is G. I. F)
64. If the equation on reflection of $\frac{(x-4)^2}{16} + \frac{(y-3)^2}{9} = 1$ about the line $x - y - 2 = 0$ is $16x^2 + 9y^2 + k_1x - 36y + k_2 = 0$ then $\frac{k_1 + k_2}{22}$ is

Space for Rough work

65. Let $A\left(\frac{1}{2}, 0\right), B\left(\frac{3}{2}, 0\right), C\left(\frac{5}{2}, 0\right)$ be the given points and P be point satisfying $\max(PA + PB, PB + PC) < 2$. If area of region of point P is $\sqrt{3}\left(\frac{\pi}{a} - \frac{\sqrt{3}}{b}\right)$ then $a + b$ is
66. Find the absolute value of $(\tan A \tan 2A) + (\tan 2A \tan 4A) + (\tan 4A \tan A)$, where $A = \frac{2\pi}{7}$.

SECTION – D
(Numerical Based XXXXX.XX answer Type)

This section contains **3 questions**. Each question, when worked out will result in numerical answer Type with answer xxxxx.xx.

67. Complex number a, b and c are zeros of polynomials $p(z) = z^3 + qz + r$ ($q, r \in \mathbb{R}$) and $|a|^2 + |b|^2 + |c|^2 = 250$. If the points corresponding to a, b and c in complex planes are vertices of a right angle triangle with hypotenuse 'h' then h^2 is:
68. Mr. A lists all the positive divisors of the number $N(2010)^2$ and selects two divisors from the list then the probability that exactly one of the selected divisors is a perfect square is:
69. If $\frac{(x-3)^{\frac{-|x|}{x}} \sqrt{(x-4)^2} (17-x)}{\sqrt{-x}(-x^2+x-1)(|x|-32)} < 0$ then no. of integers x satisfying the inequality is:

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