1. Consider the following statements :

1. $f(x) = \ln x$ is increasing in $(0, \infty)$

2. $g(x) = e^x + e^{\frac{1}{x}}$ is decreasing in $(0, \infty)$

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

2. What is the derivative of $\sin^2 x$ with respect to $\cos^2 x$?

(a) -1

(b) 1

(c) $\sin 2x$

(d) $\cos 2x$

3. For what value of m with $m < 0$, is the area bounded by the lines $y = x$, $y = mx$ and $x = 2$ equal to 3 ?

(a) $-\frac{1}{2}$

(b) -1

(c) $-\frac{3}{2}$

(d) -2

4. What is the derivative of $\text{cosec}(x^\circ)$?

(a) $-\text{cosec}(x^\circ)\cot(x^\circ)$

(b) $-\frac{\pi}{180}\text{cosec}(x^\circ)\cot(x^\circ)$

(c) $\frac{\pi}{180}\text{cosec}(x^\circ)\cot(x^\circ)$

(d) $-\frac{\pi}{180}\text{cosec}(x)\cot(x)$

5. A solution of the differential equation $\left(\frac{dy}{dx}\right)^2 - x\frac{dy}{dx} = 0$ is

(a) $y = 2x$

(b) $y = 2x + 4$

(c) $y = x^2 - 1$

(d) $y = \frac{(x^2 - 2)}{2}$

6. If $f(x) = x^2 + 2$ and $g(x) = 2x - 3$, then what is $(fg)(1)$ equal to ?

(a) 3

(b) 1

(c) -2

(d) -3

7. What is the range of the function $f(x) = x + |x|$ if the domain is the set of real numbers ?

(a) $(0, \infty)$

(b) $[0, \infty)$

(c) $(-\infty, \infty)$

(d) $[1, \infty)$

8. If $f(x) = x(4x^2 - 3)$, then what is $f(\sin\theta)$ equal to ?

(a) $-\sin 3\theta$

(b) $-\cos 3\theta$

(c) $\sin 3\theta$

(d) $-\sin 4\theta$

9. What is $\lim_{x \to 5} \frac{5-x}{|x-5|}$ equal to ?

(a) -1

(b) 0

(c) 1

(d) Limit does not exist

10. What is $\lim_{x \to 1} \frac{x^9 - 1}{x^3 - 1}$ equal to ?

(a) -1

(b) -3

(c) 3

(d) Limit does not exist

Consider the following for the next three (03) items that follow :

Let $f(x) = Pe^x + Qe^{2x} + Re^{3x}$, where P, Q, R are real numbers. Further $f(0) = 6$, $f'(\ln 3) = 282$ and $\int_0^{\ln 2} f(x)\,dx = 11$

11. What is the value of Q ?

(a) 1

(b) 2

(c) 3

(d) 4

12. What is the value of R ?

(a) 1

(b) 2

(c) 3

(d) 4

13. What is $f'(0)$ equal to ?

(a) 18

(b) 16

(c) 15

(d) 14

Consider the following for the next two (02) items that follow :

Suppose E is the differential equation representing family of curves $y^2 = 2cx + 2c\sqrt{c}$ where c is a positive parameter.

14. What is the order of the differential equation ?

(a) 1

(b) 2

(c) 3

(d) 4

15. What is the degree of the differential equation ?

(a) 2

(b) 3

(c) 4

(d) Degree does not exist

Consider the following for the next three (03) items that follow :

Let $f(x)=\begin{vmatrix} \cos x & x & 1 \\ 2\sin x & x^2 & 2x \\ \tan x & x & 1 \end{vmatrix}$

16. What is $f(0)$ equal to ?

(a) –1

(b) 0

(c) 1

(d) 2

17. What is $\lim_{x\to 0}\frac{f(x)}{x}$ equal to ?

(a) –1

(b) 0

(c) 1

(d) 2

18. What is $\lim_{x\to 0}\frac{f(x)}{x^2}$ equal to ?

(a) –1

(b) 0

(c) 1

(d) 2

Consider the following for the next two (02) items that follow :

Let $f(x)=\sin[\pi^2]x+\cos[-\pi^2]x$ where [.] is a greatest integer function

19. What is $f\left(\frac{\pi}{2}\right)$ equal to ?

(a) –1

(b) 0

(c) 1

(d) 2

20. What is $f\left(\frac{\pi}{4}\right)$ equal to ?

(a) $-\frac{1}{\sqrt{2}}$

(b) –1

(c) 1

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

Consider the following for the next two (02) items that follow :

Let $\Delta(a, b, c, \alpha) = \begin{vmatrix} a & b & a\alpha+b \\ b & c & b\alpha+c \\ a\alpha+b & b\alpha+c & 0 \end{vmatrix}$

21. If $\Delta(a, b, c, \alpha) = 0$ for every $\alpha > 0$, then which one of the following is correct ?

(a) a, b, c are in AP

(b) a, b, c are in GP

(c) a, $2b$, c are in AP

(d) a, $2b$, c are in GP

22. If $\Delta(7, 4, 2, \alpha) = 0$, then α is a root of which one of the following equations ?

(a) $7x^2 + 4x + 2 = 0$

(b) $7x^2 - 4x + 2 = 0$

(c) $7x^2 + 8x + 2 = 0$

(d) $7x^2 - 8x + 2 = 0$

Consider the following for the next two (02) items that follow :

Given that $m(\theta) = \cot^2\theta + n^2\tan^2\theta + 2n$, where n is a fixed positive real number.

23. What is the least value of $m(\theta)$?

(a) n

(b) $2n$

(c) $3n$

(d) $4n$

24. Under what condition does m attain the least value ?

(a) $n = \tan^2\theta$

(b) $n = \cot^2\theta$

(c) $n = \sin^2\theta$

(d) $n = \cos^2\theta$

Consider the following for the next two (02) items that follow :

A quadrilateral is formed by the lines $x = 0$, $y = 0$, $x + y = 1$ and $6x + y = 3$.

25. What is the equation of diagonal through origin ?

(a) $3x + y = 0$

(b) $2x + 3y = 0$

(c) $3x - 2y = 0$

(d) $3x + 2y = 0$

26. What is the equation of other diagonal ?

(a) $x + 2y - 1 = 0$

(b) $x - 2y - 1 = 0$

(c) $2x + y + 1 = 0$

(d) $2x + y - 1 = 0$

Consider the following for the next two (02) items that follow :

$P(x, y)$ is any point on the ellipse $x^2+4y^2=1$. Let E, F be the foci of the ellipse.

27. What is $PE+PF$ equal to ?

(a) 1

(b) 2

(c) 3

(d) 4

28. Consider the following points :

1. $\left(\frac{\sqrt{3}}{2}, 0\right)$

2. $\left(\frac{\sqrt{3}}{2}, \frac{1}{4}\right)$

3. $\left(\frac{\sqrt{3}}{2}, -\frac{1}{4}\right)$

Which of the above points lie on latus rectum of ellipse ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

Consider the following for the next two (02) items that follow :

The line $y=x$ partitions the circle $(x-a)^2+y^2=a^2$ in two segments.

29. What is the area of minor segment ?

(a) $\frac{(\pi-2)a^2}{4}$

(b) $\frac{(\pi-1)a^2}{4}$

(c) $\frac{(\pi-2)a^2}{2}$

(d) $\frac{(\pi-1)a^2}{2}$

30. What is the area of major segment ?

(a) $\frac{(3\pi-2)a^2}{4}$

(b) $\frac{(3\pi+2)a^2}{4}$

(c) $\frac{(3\pi-2)a^2}{2}$

(d) $\frac{(3\pi+2)a^2}{2}$

31. Consider the following frequency distribution :

x	1	2	3	5
f	4	6	9	7

What is the value of median of the distribution ?

(a) 1

(b) 2

(c) 3

(d) 3·5

32. For data $-1, 1, 4, 3, 8, 12, 17, 19, 9, 11$; if M is the median of first 5 observations and N is the median of last five observations, then what is the value of $4M - N$?

(a) 7

(b) 4

(c) 1

(d) 0

33. Let P, Q, R represent mean, median and mode. If for some distribution $5P = 4Q = \frac{R}{2}$, then what is $\frac{P+Q}{2P+0{\cdot}7R}$ equal to?

(a) $\frac{1}{12}$

(b) $\frac{1}{7}$

(c) $\frac{2}{9}$

(d) $\frac{1}{4}$

34. If G is the geometric mean of numbers $1, 2, 2^2, 2^3, \ldots, 2^{n-1}$, then what is the value of $1 + 2\log_2 G$?

(a) 1

(b) 4

(c) $n-1$

(d) n

35. If H is the harmonic mean of numbers $1, 2, 2^2, 2^3, \ldots, 2^{n-1}$, then what is n/H equal to?

(a) $2-\frac{1}{2^{n+1}}$

(b) $2-\frac{1}{2^{n-1}}$

(c) $2+\frac{1}{2^{n-1}}$

(d) $2-\frac{1}{2^n}$

36. Let P be the median, Q be the mean and R be the mode of observations $x_1, x_2, x_3, \ldots x_n$. Let $S = \sum_{i=1}^{n}(2x_i - a)^2$. S takes minimum value, when a is equal to

(a) P

(b) $\frac{Q}{2}$

(c) $2Q$

(d) R

37. One bag contains 3 white and 2 black balls, another bag contains 2 white and 3 black balls. Two balls are drawn from the first bag and put it into the second bag and then a ball is drawn from the second bag. What is the probability that it is white?

(a) $\frac{6}{7}$

(b) $\frac{33}{70}$

(c) $\frac{3}{10}$

(d) $\frac{1}{70}$

38. Three dice are thrown. What is the probability that each face shows only multiples of 3 ?

(a) $\frac{1}{9}$

(b) $\frac{1}{18}$

(c) $\frac{1}{27}$

(d) $\frac{1}{3}$

39. What is the probability that the month of December has 5 Sundays ?

(a) 1

(b) $\frac{1}{4}$

(c) $\frac{3}{7}$

(d) $\frac{2}{7}$

40. A natural number n is chosen from the first 50 natural numbers. What is the probability that $n+\frac{50}{n}<50$?

(a) $\frac{23}{25}$

(b) $\frac{47}{50}$

(c) $\frac{24}{25}$

(d) $\frac{49}{50}$

41. How many real numbers satisfy the equation $|x-4|+|x-7|=15$?

(a) Only one

(b) Only two

(c) Only three

(d) Infinitely many

42. A mapping $f: A \to B$ defined as $f(x)=\frac{2x+3}{3x+5}$, $x \in A$. If f is to be onto, then what are A and B equal to ?

(a) $A = R\setminus\{-\frac{5}{3}\}$ and $B = R\setminus\{-\frac{2}{3}\}$

(b) $A = R$ and $B = R\setminus\{-\frac{5}{3}\}$

(c) $A = R\setminus\{-\frac{3}{2}\}$ and $B = R\setminus\{0\}$

(d) $A = R\setminus\{-\frac{5}{3}\}$ and $B = R\setminus\{\frac{2}{3}\}$

43. α and β are distinct real roots of the quadratic equation $x^2+ax+b=0$. Which of the following statements is/are sufficient to find α ?

1. $\alpha+\beta=0$, $\alpha^2+\beta^2=2$

2. $\alpha\beta^2=-1$, $a=0$

Select the correct answer using the code given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

44. If the sixth term in the binomial expansion of $\left(x^{\frac{-8}{3}} + x^2 \log_{10} x\right)^8$ is 5600, then what is the value of x ?

(a) 6

(b) 8

(c) 9

(d) 10

45. How many terms are there in the expansion of $(3x-y)^4(x+3y)^4$?

(a) 9

(b) 12

(c) 15

(d) 17

46. p, q, r and s are in AP such that $p+s=8$ and $qr=15$. What is the difference between largest and smallest numbers ?

(a) 6

(b) 5

(c) 4

(d) 3

47. Consider the following statements for a fixed natural number n :

1. $C(n, r)$ is greatest if $n=2r$
2. $C(n, r)$ is greatest if $n=2r-1$ and $n=2r+1$

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

48. m parallel lines cut n parallel lines giving rise to 60 parallelograms. What is the value of $(m+n)$?

(a) 6

(b) 7

(c) 8

(d) 9

49. Let x be the number of permutations of the word 'PERMUTATIONS' and y be the number of permutations of the word 'COMBINATIONS'. Which one of the following is correct ?

(a) $x = y$

(b) $y = 2x$

(c) $x = 4y$

(d) $y = 4x$

50. 5-digit numbers are formed using the digits 0, 1, 2, 4, 5 without repetition. What is the percentage of numbers which are greater than 50,000 ?

(a) 20%

(b) 25%

(c) $\frac{100}{3}\%$

(d) $\frac{110}{3}\%$

51. If $2-i\sqrt{3}$ where $i=\sqrt{-1}$ is a root of the equation $x^2+ax+b=0$, then what is the value of $(a+b)$?

(a) -11

(b) -3

(c) 0

(d) 3

52. If $z=\dfrac{1+i\sqrt{3}}{1-i\sqrt{3}}$ where $i=\sqrt{-1}$, then what is the argument of z ?

(a) $\dfrac{\pi}{3}$

(b) $\dfrac{2\pi}{3}$

(c) $\dfrac{4\pi}{3}$

(d) $\dfrac{5\pi}{6}$

53. If a, b, c are in AP, then what is

$$\begin{vmatrix} x+1 & x+2 & x+3 \\ x+2 & x+3 & x+4 \\ x+a & x+b & x+3 \end{vmatrix}$$ equal to ?

(a) -1

(b) 0

(c) 1

(d) 2

54. If $\log_x a$, a^x and $\log_b x$ are in GP, then what is x equal to ?

(a) $\log_a(\log_b a)$

(b) $\log_b(\log_a b)$

(c) $\dfrac{\log_a(\log_b a)}{2}$

(d) $\dfrac{\log_b(\log_a b)}{2}$

55. If $2^{\frac{1}{c}}$, $2^{\frac{b}{ac}}$, $2^{\frac{1}{a}}$ are in GP, then which one of the following is correct ?

(a) a, b, c are in AP

(b) a, b, c are in GP

(c) a, b, c are in HP

(d) ab, bc, ca are in AP

56. The first and the second terms of an AP are $\frac{5}{2}$ and $\frac{23}{12}$ respectively. If n^{th} term is the largest negative term, what is the value of n ?

(a) 5

(b) 6

(c) 7

(d) n cannot be determined

57. For how many integral values of k, the equation $x^2-4x+k=0$, where k is an integer has real roots and both of them lie in the interval $(0, 5)$?

(a) 3

(b) 4

(c) 5

(d) 6

58. In an AP, the first term is x and the sum of the first n terms is zero. What is the sum of next m terms ?

(a) $\frac{mx(m+n)}{n-1}$

(b) $\frac{mx(m+n)}{1-n}$

(c) $\frac{nx(m+n)}{m-1}$

(d) $\frac{nx(m+n)}{1-m}$

59. Consider the following statements :

1. (25)! + 1 is divisible by 26
2. (6)! + 1 is divisible by 7

Which of the above statements is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

60. If z is a complex number such that $\frac{z-1}{z+1}$ is purely imaginary, then what is $|z|$ equal to ?

(a) $\frac{1}{2}$

(b) $\frac{2}{3}$

(c) 1

(d) 2

61. If ω is a non-real cube root of 1, then what is the value of $\left|\frac{1-\omega}{\omega+\omega^2}\right|$?

(a) $\sqrt{3}$

(b) $\sqrt{2}$

(c) 1

(d) $\frac{4}{\sqrt{3}}$

62. What is the number of 6-digit numbers that can be formed only by using 0, 1, 2, 3, 4 and 5 (each once); and divisible by 6 ?

(a) 96

(b) 120

(c) 192

(d) 312

63. What is the binary number equivalent to decimal number 1011 ?

(a) 1011

(b) 111011

(c) 11111001

(d) 111110011

64. Let A be a matrix of order 3×3 and $|A| = 4$. If $|2\,\text{adj}(3A)| = 2^{\alpha}3^{\beta}$, then what is the value of $(\alpha+\beta)$?

(a) 12

(b) 13

(c) 17

(d) 24

65. If α and β are the distinct roots of equation $x^2 - x + 1 = 0$, then what is the value of $\left|\frac{\alpha^{100} + \beta^{100}}{\alpha^{100} - \beta^{100}}\right|$?

(a) $\sqrt{3}$

(b) $\sqrt{2}$

(c) 1

(d) $\frac{1}{\sqrt{3}}$

66. Let A and B be symmetric matrices of same order, then which one of the following is correct regarding $(AB - BA)$?

1. Its diagonal entries are equal but nonzero
2. The sum of its non-diagonal entries is zero

Select the correct answer using the code given below :

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

67. Consider the following statements in respect of square matrices A, B, C each of same order n :

1. $AB = AC \Rightarrow B = C$ if A is non-singular
2. If $BX = CX$ for every column matrix X having n rows then $B = C$

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

68. The system of linear equations $x + 2y + z = 4$, $2x + 4y + 2z = 8$ and $3x + 6y + 3z = 10$ has

(a) a unique solution

(b) infinite many solutions

(c) no solution

(d) exactly three solutions

69. Let $AX = B$ be a system of 3 linear equations with 3-unknowns. Let X_1 and X_2 be its two distinct solutions. If the combination $aX_1 + bX_2$ is a solution of $AX = B$; where a, b are real numbers, then which one of the following is correct ?

(a) $a = b$

(b) $a + b = 1$

(c) $a + b = 0$

(d) $a - b = 1$

70. What is the sum of the roots of the equation $\begin{vmatrix} 0 & x-a & x-b \\ 0 & 0 & x-c \\ x+b & x+c & 1 \end{vmatrix} = 0$?

(a) $a + b + c$

(b) $a - b + c$

(c) $a + b - c$

(d) $a - b - c$

Consider the following for the next two (02) items that follow :

Let $A(1, -1, 2)$ and $B(2, 1, -1)$ be the end points of the diameter of the sphere $x^2 + y^2 + z^2 + 2ux + 2vy + 2wz - 1 = 0$.

71. What is $u + v + w$ equal to ?

(a) –2

(b) –1

(c) 1

(d) 2

72. If $P(x, y, z)$ is any point on the sphere, then what is $PA^2 + PB^2$ equal to ?

(a) 15

(b) 14

(c) 13

(d) 6·5

Consider the following for the next two (02) items that follow :

Consider two lines whose direction ratios are $(2, -1, 2)$ and $(k, 3, 5)$. They are inclined at an angle $\frac{\pi}{4}$.

73. What is the value of k ?

(a) 4

(b) 2

(c) 1

(d) –1

74. What are the direction ratios of a line which is perpendicular to both the lines ?

(a) (1, 2, 10)

(b) (–1, –2, 10)

(c) (11, 12, –10)

(d) (11, 2, –10)

Consider the following for the next two (02) items that follow :

Let $\vec{a} = 3\hat{i} + 3\hat{j} + 3\hat{k}$ and $\vec{c} = \hat{j} - \hat{k}$. Let $\vec{b}$ be such that $\vec{a} \cdot \vec{b} = 27$ and $\vec{a} \times \vec{b} = \vec{9c}$

75. What is $\vec{b}$ equal to ?

(a) $3\hat{i} + 4\hat{j} + 2\hat{k}$

(b) $5\hat{i} + 2\hat{j} + 2\hat{k}$

(c) $5\hat{i} - 2\hat{j} + 6\hat{k}$

(d) $3\hat{i} + 3\hat{j} + 4\hat{k}$

76. What is the angle between $(\vec{a}+\vec{b})$ and $\vec{c}$?

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

(b) $\frac{\pi}{3}$

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

(d) $\frac{\pi}{6}$

Consider the following for the next two (02) items that follow :

Let a vector $\vec{a}=4\hat{i}-8\hat{j}+\hat{k}$ make angles α, β, γ with the positive directions of x, y, z axes respectively.

77. What is $\cos\alpha$ equal to ?

(a) $\frac{1}{3}$

(b) $\frac{4}{9}$

(c) $\frac{5}{9}$

(d) $\frac{2}{3}$

78. What is $\cos2\beta+\cos2\gamma$ equal to ?

(a) $-\frac{32}{81}$

(b) $-\frac{16}{81}$

(c) $\frac{16}{81}$

(d) $\frac{32}{81}$

Consider the following for the next two (02) items that follow :

The position vectors of two points A and B are $\hat{i}-\hat{j}$ and $\hat{j}+\hat{k}$ respectively.

79. Consider the following points :

1. (–1, –3, 1)

2. (–1, 3, 2)

3. (–2, 5, 3)

Which of the above points lie on the line joining A and B ?

(a) 1 and 2 only

(b) 2 and 3 only

(c) 1 and 3 only

(d) 1, 2 and 3

80. What is the magnitude of $\overrightarrow{AB}$?

(a) 2

(b) 3

(c) $\sqrt{6}$

(d) $\sqrt{3}$

81. The mean and variance of five observations are 14 and 13·2 respectively. Three of the five observations are 11, 16 and 20. What are the other two observations ?

(a) 8 and 15

(b) 9 and 14

(c) 10 and 13

(d) 11 and 12

82. Let A and B be two independent events such that
$P(\overline{A}) = 0{\cdot}7$, $P(\overline{B}) = k$, $P(A \cup B) = 0{\cdot}8$.
What is the value of k ?

(a) $\frac{5}{7}$

(b) $\frac{4}{7}$

(c) $\frac{2}{7}$

(d) $\frac{1}{7}$

83. A biased coin with the probability of getting head equal to $\frac{1}{4}$ is tossed five times. What is the probability of getting tail in all the first four tosses followed by head ?

(a) $\frac{81}{512}$

(b) $\frac{81}{1024}$

(c) $\frac{81}{256}$

(d) $\frac{27}{1024}$

84. A coin is biased so that heads comes up thrice as likely as tails. In four independent tosses of the coin, what is probability of getting exactly three heads ?

(a) $\frac{81}{256}$

(b) $\frac{27}{64}$

(c) $\frac{27}{256}$

(d) $\frac{9}{256}$

85. Let X and Y be two random variables such that $X + Y = 100$. If X follows Binomial distribution with parameters $n = 100$ and $p = \frac{4}{5}$, what is the variance of Y ?

(a) 1

(b) $\frac{1}{2}$

(c) 16

(d) $\frac{1}{16}$

86. If two lines of regression are $x+4y+1=0$ and $4x+9y+7=0$, then what is the value of x when $y=-3$?

(a) -13

(b) -5

(c) 5

(d) 7

87. The central angles p, q, r and s (in degrees) of four sectors in a Pie Chart satisfy the relation $9p=3q=2r=6s$. What is the value of $4p-q$?

(a) 12

(b) 24

(c) 30

(d) 36

88. The observations 4, 1, 4, 3, 6, 2, 1, 3, 4, 5, 1, 6 are outputs of 12 dices thrown simultaneously. If m and M are means of lowest 8 observations and highest 4 observations respectively, then what is $(2m+M)$ equal to ?

(a) 10

(b) 12

(c) 17

(d) 21

89. A bivariate data set contains only two points (–1, 1) and (3, 2). What will be the line of regression of y on x ?

(a) $x-4y+5=0$

(b) $3x+2y-1=0$

(c) $x+4y+1=0$

(d) $5x-4y+1=0$

90. A die is thrown 10 times and obtained the following outputs :

1, 2, 1, 1, 2, 1, 4, 6, 5, 4

What will be the mode of data so obtained ?

(a) 6

(b) 4

(c) 2

(d) 1

Consider the following for the next three (03) items that follow :

Let $I_1=\int_0^{\pi}\frac{x}{1+\cos^2 x}dx$ and

$I_2=\int_0^{\pi}\frac{1}{1+\sin^2 x}dx$

91. What is the value of $\frac{I_1+I_2}{I_1-I_2}$?

(a) 1

(b) π

(c) π^2

(d) $\frac{\pi+1}{\pi-1}$

92. What is the value of $8I_1^2$?

(a) π

(b) π^2

(c) π^3

(d) π^4

93. What is the value of I_2 ?

(a) $\frac{\pi}{\sqrt{2}}$

(b) $\frac{\pi}{2\sqrt{2}}$

(c) $\frac{3\pi}{2\sqrt{2}}$

(d) $\frac{\pi}{4\sqrt{2}}$

Consider the following for the next two (02) items that follow :

Let $I = \int_a^b \frac{|x|}{x} dx$, $a < b$

94. What is I equal to when $a < 0 < b$?

(a) $a + b$

(b) $a - b$

(c) $b - a$

(d) $\frac{(a+b)}{2}$

95. What is I equal to when $a < b < 0$?

(a) $a + b$

(b) $a - b$

(c) $b - a$

(d) $\frac{(a+b)}{2}$

Consider the following for the next three (03) items that follow :

Let $f(x) = |\ln x|, x \neq 1$

96. What is the derivative of $f(x)$ at $x = 0{\cdot}5$?

(a) -2

(b) -1

(c) 1

(d) 2

97. What is the derivative of $f(x)$ at $x = 2$?

(a) $-\frac{1}{2}$

(b) -1

(c) $\frac{1}{2}$

(d) 2

98. What is the derivative of $f \circ f(x)$, where $1 < x < 2$?

(a) $\frac{1}{lnx}$

(b) $\frac{1}{xlnx}$

(c) $-\frac{1}{lnx}$

(d) $-\frac{1}{xlnx}$

Consider the following for the next two (02) items that follow :

Let $f(x) = \begin{cases} x+6, & x \leq 1 \\ px+q, & 1 < x < 2 \\ 5x, & x \geq 2 \end{cases}$

and $f(x)$ is continuous

99. What is the value of p ?

(a) 2

(b) 3

(c) 4

(d) 5

100. What is the value of q ?

(a) 2

(b) 3

(c) 4

(d) 5

Consider the following for the next two (02) items that follow :

Consider the function

$f(x) = |x-2| + |3-x| + |4-x|$, where $x \in R$.

101. At what value of x does the function attain minimum value ?

(a) 2

(b) 3

(c) 4

(d) 0

102. What is the minimum value of the function ?

(a) 2

(b) 3

(c) 4

(d) 0

Consider the following for the next two (02) items that follow

Consider the sum

$S = 0! + 1! + 2! + 3! + 4! + \ldots + 100!$

103. If the sum S is divided by 8, what is the remainder ?

(a) 0

(b) 1

(c) 2

(d) Cannot be determined

104. If the sum S is divided by 60, what is the remainder ?

(a) 1

(b) 3

(c) 17

(d) 34

Consider the following for the next two (02) items that follow :

In a triangle PQR, P is the largest angle and $\cos P = \frac{1}{3}$. Further the in-circle of the triangle touches the sides PQ, QR and RP at N, L and M respectively such that the lengths PN, QL and RM are n, $n+2$, $n+4$ respectively where n is an integer.

105. What is the value of n ?

(a) 4

(b) 6

(c) 8

(d) 10

106. What is the length of the smallest side ?

(a) 12

(b) 14

(c) 16

(d) 18

Consider the following for the next two (02) items that follow :

Given that

$\sin x + \cos x + \tan x + \cot x + \sec x + \operatorname{cosec} x = 7$

107. The given equation can be reduced to

(a) $\sin^2 2x - 44\sin 2x + 36 = 0$

(b) $\sin^2 2x + 44\sin 2x - 36 = 0$

(c) $\sin^2 2x - 22\sin 2x + 18 = 0$

(d) $\sin^2 2x + 22\sin 2x - 18 = 0$

108. If $\sin 2x = a - b\sqrt{c}$, where a and b are natural numbers and c is prime number, then what is the value of $a - b + 2c$?

(a) 0

(b) 14

(c) 21

(d) 28

Consider the following for the next two (02) items that follow :

A quadratic equation is given by

$\left(3+2\sqrt{2}\right)x^2 - \left(4+2\sqrt{3}\right)x + \left(8+4\sqrt{3}\right) = 0$

109. What is the HM of the roots of the equation ?

(a) 2

(b) 4

(c) $2\sqrt{2}$

(d) $2\sqrt{3}$

110. What is the GM of the roots of the equation ?

(a) $\sqrt{2}\left(\sqrt{6}-\sqrt{3}+\sqrt{2}-1\right)$

(b) $\sqrt{2}\left(\sqrt{6}+\sqrt{3}-\sqrt{2}-1\right)$

(c) $\left(\sqrt{6}-\sqrt{3}+\sqrt{2}-1\right)$

(d) $\left(\sqrt{6}+\sqrt{3}+\sqrt{2}-1\right)$

Consider the following for the next two (02) items that follow :

Let $\sin\beta$ be the GM of $\sin\alpha$ and $\cos\alpha$; $\tan\gamma$ be the AM of $\sin\alpha$ and $\cos\alpha$.

111. What is $\cos2\beta$ equal to ?

(a) $(\cos\alpha - \sin\alpha)^2$

(b) $(\cos\alpha + \sin\alpha)^2$

(c) $(\cos\alpha - \sin\alpha)^3$

(d) $\frac{(\cos\alpha-\sin\alpha)^2}{2}$

112. What is the value of $\sec2\gamma$?

(a) $\frac{3-\sin2\alpha}{5+2\sin2\alpha}$

(b) $\frac{5+\sin2\alpha}{3-\sin2\alpha}$

(c) $\frac{3-2\sin2\alpha}{4+\sin2\alpha}$

(d) $\frac{3-\sin2\alpha}{4+3\sin2\alpha}$

Consider the following for the next two (02) items that follow :

A flagstaff 20 m long standing on a pillar 10 m high subtends an angle $\tan^{-1}(0{\cdot}5)$ at a point P on the ground. Let θ be the angle subtended by the pillar at this point P.

113. If x is the distance of P from bottom of the pillar, then consider the following statements :

1. x can take two values which are in the ratio 1 : 3
2. x can be equal to height of the flagstaff

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

114. What is a possible value of $\tan\theta$?

(a) $\frac{3}{4}$

(b) $\frac{2}{3}$

(c) $\frac{1}{3}$

(d) $\frac{1}{4}$

Consider the following for the next two (02) items that follow :

The perimeter of a triangle ABC is 6 times the AM of sine of angles of the triangle. Further $BC=\sqrt{3}$ and $CA=1$.

115. What is the perimeter of the triangle ?

(a) $\sqrt{3}+1$

(b) $\sqrt{3}+2$

(c) $\sqrt{3}+3$

(d) $2\sqrt{3}+1$

116. Consider the following statements :

1. ABC is right angled triangle
2. The angles of the triangle are in AP

Which of the statements given above is/are correct ?

(a) 1 only

(b) 2 only

(c) Both 1 and 2

(d) Neither 1 nor 2

Consider the following for the next two (02) items that follow :

Let $x=\dfrac{\sin^2 A+\sin A+1}{\sin A}$ where $0<A\leq\dfrac{\pi}{2}$

117. What is the minimum value of x ?

(a) 1

(b) 2

(c) 3

(d) 4

118. At what value of A does x attain the minimum value ?

(a) $\dfrac{\pi}{6}$

(b) $\dfrac{\pi}{4}$

(c) $\dfrac{\pi}{3}$

(d) $\dfrac{\pi}{2}$

Consider the following for the next two (02) items that follow :

In the triangle ABC,

$$a^2+b^2+c^2=ac+\sqrt{3}bc$$

119. What is the nature of the triangle ?

(a) Equilateral

(b) Isosceles

(c) Right angled triangle

(d) Scalene but not right angled

120. If $c=8$, what is the area of the triangle ?

(a) $4\sqrt{3}$

(b) $6\sqrt{3}$

(c) $8\sqrt{3}$

(d) $12\sqrt{3}$