

1. Which of the following subset of \mathbb{R}^2 is countable:

- (A) $\{(a, b) \in \mathbb{R}^2 \mid a \leq b\}$
- (B) $\{(a, b) \in \mathbb{R}^2 \mid a + b \in \mathbb{Q}\}$
- (C) $\{(a, b) \in \mathbb{R}^2 \mid ab \in \mathbb{Z}\}$
- (D) $\{(a, b) \in \mathbb{R}^2 \mid a, b \in \mathbb{Q}\}$

2. Which of the following subset of \mathbb{R}^2 is bounded:

- (A) $\{(x, y) \in \mathbb{R}^2 : x = 2y\}$
- (B) $\{(x, y) \in \mathbb{R}^2 : x^2 < 4y\}$
- (C) $\{(x, y) \in \mathbb{R}^2 : 1 > \frac{x^2}{10} + \frac{y^2}{5}\}$
- (D) $\{(x, y) \in \mathbb{R}^2 : x^2 + y^2 > 10\}$

3. Which of the following is true:

- (A) The set of all solutions of the equation $z^n = 1$ is countable, where z is a complex number.
- (B) The set $\{e^{2x} : x \in \mathbb{R}\}$ is countable set.
- (C) \mathbb{N} is an uncountable set.
- (D) $\{\sin x : x \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]\}$ is countable.

4. If $A = \{x : x = \frac{4n+5}{n}, n \in \mathbb{N}\}$, then Sup A and Inf A are respectively:

- (A) 4, 4
- (B) 9, 4
- (C) 4, 9
- (D) None of these

5. If $Y = \{\frac{x}{1+|x|} : x \in \mathbb{R}\}$, then the set of all limit points of Y is

- (A) $[-1, 1]$
- (B) $[-1, 1]$
- (C) $[0, 1]$
- (D) $[-1, 1]$

6. $\lim_{x \rightarrow 0^+} \frac{9}{x} \left(\frac{1}{\tan^{-1} x} - \frac{1}{x} \right)$ is

- (A) 1 (B) 2
(C) 3 (D) 0

7. If $f: \mathbb{N} \rightarrow \mathbb{Z}$ defined by

$$f(n) = \begin{cases} \frac{n-1}{2} & \text{when } n \text{ is odd} \\ \frac{-n}{2} & \text{when } n \text{ is even} \end{cases}$$

then f is

- (A) one-one but not onto (B) onto but not one-one
(C) bijective (D) neither one-one nor onto

8. The sequence $\{T_n\}$ where

$$T_n = 1 + \frac{1}{3} + \frac{1}{5} + \dots + \frac{1}{2n-1}$$

- (A) Convergent (B) Monotonically decreasing
(C) Not Cauchy (D) None of these

9. Let $\{a_n\}$, $\{b_n\}$ and $\{c_n\}$ be sequences of real numbers such that $b_n = a_{2n}$ and $c_n = a_{2n+1}$. Then $\{a_n\}$ is convergent

- (A) implies both $\{c_n\}$ and $\{b_n\}$ are convergent.
(B) if both $\{b_n\}$ and $\{c_n\}$ are convergent.
(C) implies $\{b_n\}$ is convergent but $\{c_n\}$ need not be convergent.
(D) implies $\{c_n\}$ is convergent but $\{b_n\}$ need not be convergent.

10. The value of $\lim_{n \rightarrow \infty} \sum_{k=1}^n \frac{1}{\sqrt{n^2 + kn}}$ is

- (A) $2(\sqrt{2} - 1)$ (B) $2\sqrt{2} - 1$
(C) $2 - \sqrt{2}$ (D) $\frac{1}{2}(\sqrt{2} - 1)$

11. Let $\langle a_n \rangle$ be a sequence of non negative real numbers such that $\sum a_n$ is convergent. If p is a

real number such that $\sum \frac{\sqrt{a_n}}{n^p}$ is divergent, then

(A) $p > 1/2$

(B) $p \leq 1/2$

(C) $p < 1/3$

(D) None of these

12. Let $f(x) = (x - 2)^{17}(x + 15)^{24}$. Then :

(A) f does not have a critical point at 2.

(B) f has a minimum at 2.

(C) f has a maximum at 2.

(D) f has neither maximum nor minimum at 2.

13. Let $a_n = \sin\left(\frac{1}{n^3}\right)$ and $b_n = \sin\left(\frac{1}{n}\right)$ for $n \in \mathbb{N}$. Then

(A) both $\sum a_n$ and $\sum b_n$ are convergent.

(B) $\sum a_n$ is convergent but $\sum b_n$ is not convergent.

(C) $\sum a_n$ is not convergent but $\sum b_n$ is convergent.

(D) both $\sum a_n$ and $\sum b_n$ are not convergent.

14. $\lim_{n \rightarrow \infty} \frac{1}{n}(1 + \sqrt{2} + \sqrt{3} + \dots + \sqrt{n})$ is equal to

(A) 0

(B) 1

(C) 2

(D) does not exist

15. The function $f(x) = \begin{cases} x^2 \sin\left(\frac{1}{x}\right), & \text{if } x \neq 0 \\ 0, & \text{if } x = 0 \end{cases}$ is

(A) differentiable at $x = 0$

(B) continuous at $x = 0$ but not differentiable at $x = 0$

(C) neither continuous nor differentiable at $x = 0$

(D) none of these

16. Let $f: \mathbb{R}^2 \rightarrow \mathbb{R}$, defined by $f(x, y) = \begin{cases} \frac{xy}{|x|}, & \text{if } x \neq 0 \\ 0, & \text{else where} \end{cases}$ then at $(0,0)$ the function is

- (A) continuous (B) not continuous
(C) differentiable (D) none

17. Let $f_n(x) = \frac{x^n}{1+x}$ and $g_n(x) = \frac{x^n}{1+nx}$ for $x \in \mathbb{N}$. Then on the interval $[0,1]$

- (A) both f_n and g_n converges uniformly
(B) neither f_n nor g_n converges uniformly
(C) f_n converges uniformly but g_n does not
(D) g_n converges uniformly but f_n does not

18. The coefficient of $(x-1)^2$ in the Taylor series expansion of $f(x) = xe^x$ ($x \in \mathbb{R}$) about the point $x = 1$ is

- (A) $\frac{e}{2}$ (B) $2e$
(C) $\frac{3e}{2}$ (D) $3e$

19. The largest eigen value of the matrix $\begin{bmatrix} 1 & 4 & 16 \\ 4 & 16 & 1 \\ 16 & 1 & 4 \end{bmatrix}$ is

- (A) 16 (B) 21
(C) 48 (D) 64

20. Which one of the following is a subspace of the vector space \mathbb{R}^3 over \mathbb{R} ?

- (A) $\{(x, y, z) \in \mathbb{R}^3 : x + 2y = 0, 2x + 3z = 0\}$
(B) $\{(x, y, z) \in \mathbb{R}^3 : 2x + 3y + 4z - 3 = 0\}$
(C) $\{(x, y, z) \in \mathbb{R}^3 : x \geq 0, y = 0\}$
(D) $\{(x, y, z) \in \mathbb{R}^3 : x - 1 = 0, y = 0\}$

21. Let $T : \mathbb{R}^3 \rightarrow \mathbb{R}^3$ be the linear transformation defined by
- $$T(x, y, z) = (x + y, y + z, z + x)$$
- for all $(x, y, z) \in \mathbb{R}^3$. Then
- (A) $\text{rank}(T) = 0, \text{nullity}(T) = 3$ (B) $\text{rank}(T) = 2, \text{nullity}(T) = 1$
(C) $\text{rank}(T) = 1, \text{nullity}(T) = 2$ (D) $\text{rank}(T) = 3, \text{nullity}(T) = 0$
22. Suppose v_1, v_2, v_3, v_4 are linearly independent vectors of a real vector space. Consider the two sets of vectors
- $$S_1 = \{v_1 + v_2, v_1 + v_3, v_1 + v_4\}$$
- $$S_2 = \{v_1 + v_2, v_1 + v_3, v_1 + v_4, v_4 + v_1\}$$
- Which of the following is true?
- (A) Both S_1 and S_2 are linearly independent
(B) S_2 is linearly independent but not S_1
(C) S_1 is linearly independent but not S_2
(D) Neither S_1 nor S_2 is linearly independent
23. Let A be a real 3×4 matrix of rank 2. Then the rank of $A^t A$, where A^t denotes the transpose of A , is:
- (A) exactly 2
(B) exactly 3
(C) exactly 4
(D) None
24. If A is a 5×5 real matrix with trace 15 and if 2 and 3 are eigenvalues of A , each with algebraic multiplicity 2, then the determinant of A is equal to:
- (A) 0 (B) 24
(C) 120 (D) 180

25. The dimension of the vector space of all symmetric matrices $A = (a_{jk})$ of order $n \times n$ ($n \geq 2$) with real entries, $a_{11} = 0$ and trace zero is

(A) $\frac{n^2 + n - 4}{2}$

(B) $\frac{n^2 - n + 4}{2}$

(C) $\frac{n^2 + n - 3}{2}$

(D) $\frac{n^2 - n + 3}{2}$

26. Let $V = \{(x_1, \dots, x_{100}) \in \mathbb{R}^{100} : x_1 = \dots = x_{50} \text{ and } x_{51} + x_{52} + \dots + x_{100} = 0\}$. Then

(A) $\dim V = 98$

(B) $\dim V = 51$

(C) $\dim V = 49$

(D) $\dim V = 50$

27. Let M be the space of all 4×3 matrices with entries in the finite field of three elements. Then the number of matrices of rank three in M is

(A) $(3^4 - 3)(3^4 - 3^2)(3^4 - 3^3)$

(B) $(3^4 - 1)(3^4 - 2)(3^4 - 3)$

(C) $(3^4 - 1)(3^4 - 3)(3^4 - 3^2)$

(D) $3^4(3^4 - 1)(3^4 - 2)$

28. Let A be an $n \times n$ real matrix. Consider the following statements:

S_1 : If the rank of A is equal to n , then the rank of the adjoint matrix of A is also equal to n .

S_2 : If the rank of A is equal to $n - 2$, then the rank of the adjoint matrix of A is also equal to $n - 2$.

Pick up a true statement from the following:

(A) S_1 and S_2 are true

(B) S_1 is true but not S_2

(C) S_2 is true but not S_1

(D) Neither S_1 nor S_2 is true

29. Let A and B be two $n \times n$ real matrices. Consider the two statements:

(I) If $I - AB$ is invertible, then $I - BA$ is invertible.

(II) If $I - AB$ is invertible, then AB is invertible.

Then:

(A) Both (I) and (II) are true

(B) Both (I) and (II) are false

(C) (I) is true and (II) is false

(D) (I) is false and (II) is true

30. The least positive integer n , such that $\begin{bmatrix} \cos \frac{\pi}{4} & \sin \frac{\pi}{4} \\ -\sin \frac{\pi}{4} & \cos \frac{\pi}{4} \end{bmatrix}^n$ is the identity matrix is

- (A) 4 (B) 8
(C) 12 (D) 16

31. Let A be a 3×3 matrix with eigenvalues $1, -1, 0$. Then the determinant of $I + A^{100}$ is

- (A) 6 (B) 4
(C) 9 (D) 100

32. The differential equation $(1 + x^2y^3 + \alpha x^2y^2) dx + (2 + x^3y^2 + x^3y) dy = 0$ is exact, if α equals to

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

33. An integrating factor for the differential equation $(2xy + 3x^2y + 6y^3) dx + (x^2 + 6y^2) dy = 0$ is

- (A) x^3 (B) y^3
(C) e^{3x} (D) e^{3y}

34. The value of $\alpha \in R$ for which the curves $x^2 + \alpha y^2 = 1$ and $y = x^2$ intersect orthogonally is

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

35. If $y(t)$ is a solution of the differential equation $y'' + 4y = 2e^t$, then $\lim_{t \rightarrow \infty} e^{-t} y(t)$ is equal to:

- (A) $\frac{2}{3}$ (B) $\frac{2}{5}$
(C) $\frac{2}{7}$ (D) $\frac{2}{9}$

36. If the solution of the differential equation $\frac{dx}{dy} = y - x$ passes through $(0,0)$ and $(\alpha, 1)$ then value of α is
- (A) $2 - e^{-1}$ (B) $1 - e^{-1}$
 (C) e^{-1} (D) $1 + e$
37. The orthogonal trajectories of the family of curves $y = C_1 x^3$ are
- (A) $2x^2 + 3y^2 = C_2$ (B) $3x^2 + y^2 = C_2$
 (C) $3x^2 + 2y^2 = C_2$ (D) $x^2 + 3y^2 = C_2$
38. Let $y_1(x), y_2(x)$ and $y_3(x)$ be linearly independent solutions of the differential equation $\frac{d^3 y}{dx^3} - 6\frac{d^2 y}{dx^2} + 11\frac{dy}{dx} = 0$. If the Wronskian $W(y_1, y_2, y_3)$ is of the form $k e^{bx}$ for some constant k , then the value of b is _____.
- (A) 2 (B) 4
 (C) 6 (D) 8
39. The solution $y(x)$ of the differential equation $\frac{d^2 y}{dx^2} + 4\frac{dy}{dx} + 4y = 0$ satisfying the conditions $y(0) = 4, y'(0) = 8$ is
- (A) $4e^{2x}$ (B) $(16x+4)e^{-2x}$
 (C) $4e^{-2x} + 16x$ (D) $4e^{-2x} + 16xe^{2x}$
40. Particular integral of differential equation $y''' - y' = e^{-x}$ is
- (A) $\frac{xe^{-x}}{2}$ (B) $\frac{e^{-x}}{2}$
 (C) $\frac{-xe^{-x}}{3}$ (D) e^{-x}
41. Which is not necessarily a normal subgroup of a group G ?
- (A) G (B) $\{e\}$, where e is the identity element of G
 (C) The centre Z of G (D) The normaliser of an element $a \in G$

42. If H is a subgroup and N is a normal subgroup of a group G , then
- (A) $H \cup N$ is normal subgroup of G
 (B) HN is normal subgroup of G
 (C) $H \cap N$ is normal subgroup of H
 (D) None of these
43. The number of group homomorphisms from \mathbb{Z}_3 to \mathbb{Z}_9 is:
- (A) 4 (B) 5
 (C) 3 (D) 6
44. Which one of the following is not a cyclic group?
- (A) \mathbb{Z}_4 (B) \mathbb{Z}_6
 (C) \mathbb{Z}_8 (D) \mathbb{Z}_4
45. The order of the symmetric group S_7 is:
- (A) $7!$ (B) $4!$
 (C) $5!$ (D) $\frac{7!}{2}$
46. The set M of square matrices (of same order) with respect to matrix multiplication is
- (A) Group (B) Semi group
 (C) Monoid (D) None of these .
47. Let G be an Abelian group of order 10. Let $S = \{g \in G : g^{-1} = g\}$. Then the number of non-identity elements in S is:
- (A) 1 (B) 2
 (C) 4 (D) 0
48. The number of all subgroups of the group $(\mathbb{Z}_{60}, +)$ of integers modulo 60 is:
- (A) 2 (B) 10
 (C) 12 (D) 60

49. $SL(n, \mathbb{R})$ is the group of all
- (A) $n \times n$ real matrices with $\det \neq 0$ (B) $n \times n$ real matrices with $\det = 1$
 (C) $n \times n$ symmetric real matrices (D) $n \times n$ orthogonal real matrices
50. The unit digit of the number 2^{10} is
- (A) 2 (B) 6
 (C) 4 (D) 8
51. Let a relation R be defined over the set of rational numbers Q by $a R b$ if $a > b$. Then this relation is
- (A) reflexive, but not symmetric and transitive
 (B) symmetric, but not reflexive and transitive
 (C) transitive, but not reflexive and symmetric
 (D) not transitive, but reflexive and symmetric
52. The remainder of $(37)^{49}$ when divided by 7 is:
- (A) 3 (B) 1
 (C) 2 (D) 6
53. If a set A has n elements, then the number of all relations on A is:
- (A) 2^{n^2} (B) n^2
 (C) 2^n (D) $2n$
54. The smallest positive integer n such that $5^n - 1$ is divisible by 36 is:
- (A) 2 (B) 3
 (C) 5 (D) 6
55. Let G be a group of order 231, then number of elements of order 11 in G
- (A) 11 (B) 12
 (C) 10 (D) 13

56. Let $G = \{e, x, x^2, x^3, y, xy, x^2y, x^3y\}$ with $o(x)=4$, $o(y)=2$ and $xy = yx^3$ then the number of elements of the group is:
- (A) 1 (B) 2
(C) 4 (D) 8
57. Pick the correct statement
- S_1 : Every group of order 36 is abelian
 S_2 : A group in which every element is of order at most 2 is abelian
- (A) S_1 is true (B) S_2 is true
(C) Both are true (D) None
58. The value of $\int_{x=0}^1 \int_{y=0}^{x^2} \int_{z=0}^y (y+2z) dz dy dx$ is
- (A) 1/53 (B) 2/21
(C) 1/6 (D) 5/3
59. Let S be the oriented surface $x^2 + y^2 + z^2 = 1$ with the unit normal n pointing outward. For the vector field $F(x, y, z) = x\hat{i} + y\hat{j} + z\hat{k}$, the value of $\iint_S F \cdot n dS$ is:
- (A) $\frac{\pi}{3}$ (B) 2π
(C) $\frac{4\pi}{3}$ (D) 4π
60. Let C be the boundary of region $R = \{(x, y) \in \mathbb{R}^2 : -1 \leq y \leq 1, 0 \leq x \leq 1 - y^2\}$ oriented in the counter-clockwise direction. Then the value of $\oint_C y dx + 2x dy$ is
- (A) $\frac{-4}{3}$ (B) $\frac{-2}{3}$
(C) $\frac{2}{3}$ (D) $\frac{4}{3}$

61. The value of constant a for which the divergence of the vector $f = (x + 3y)\hat{i} + (y - 2z)\hat{j} + (x + \alpha z)\hat{k}$ is 0 is:
 (A) 1 (B) 2
 (C) -2 (D) -1
62. If $\vec{a} = a_1\hat{i} + a_2\hat{j} + a_3\hat{k}$ is a constant vector and $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ then $(\vec{a} \cdot \nabla)\vec{r}$ is equal to
 (A) (\vec{a}) (B) $(\vec{a} \cdot \vec{r})\vec{r}$
 (C) $3(\vec{a})$ (D) $2(\vec{a})$
63. The equation of a surface of revolution is $z = \pm \sqrt{\frac{3}{2}x^2 + \frac{3}{2}y^2}$. The unit normal to the surface at the point A $\left(\sqrt{\frac{2}{3}}, 0, 1\right)$ is:
 (A) $\sqrt{\frac{3}{5}}\hat{i} + \frac{2}{10}\hat{k}$ (B) $\sqrt{\frac{3}{5}}\hat{i} - \frac{2}{\sqrt{10}}\hat{k}$
 (C) $\sqrt{\frac{3}{5}}\hat{i} + \frac{2}{\sqrt{5}}\hat{k}$ (D) $\sqrt{\frac{3}{10}}\hat{i} + \frac{2}{\sqrt{10}}\hat{k}$
64. Consider the vector field $\vec{F} = (\alpha x + y + \alpha)\hat{i} + \hat{j} - (x + y)\hat{k}$, where α is a constant. If $(\vec{F}) \cdot \text{curl}(\vec{F}) = 0$ then the value of α is
 (A) 1 (B) 0
 (C) 1 (D) $\frac{3}{2}$
65. Consider the function $f(z) = x^2 + y^2 + 2ixy$, ($z = x + iy \in \mathbb{C}$), which one of the following is true?
 (A) f is differentiable only at $z = 0$.
 (B) f is differentiable only at the points that lie on the X-axis.
 (C) f is differentiable only at the points that lie on the Y-axis.
 (D) None of these.

66. The radius of convergence of the power series:

$$\sum_{n=0}^{\infty} n^2 z^n \text{ is } \underline{\hspace{2cm}}$$

$$n = 0$$

(A) 1

(B) -1

(C) 0

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

67. The value of the integral $\int_{\{|z|=2\}} \frac{\cos z \, dz}{z^3}$ is .

(A) $i\pi$

(B) $2i\pi$

(C) $-2i\pi$

(D) $-i\pi$

68. The derivative of $f(z) = (iz^3 + 3z^2)^3$ at $z = 2i$ is:

(A) 3

(B) 2

(C) 1

(D) 0

69. If a function $f(z) = u(x, y) + iv(x, y)$, then the Cauchy-Riemann conditions are:

(A) $u_x = v_y$ and $u_y = v_x$

(B) $u_x = -v_y$ and $u_y = v_x$

(C) $u_x = v_y$ and $u_y = -v_x$

(D) $-u_x = v_y$ and $u_y = -v_x$

70. The function $f(z) = z\bar{z} + 1$ in the form $u(x, y) + iv(x, y)$ is:

(A) $(x^2 - y^2 + 1) + 0i$

(B) $(x^2 + y^2 - 1) + 2i$

(C) $(x^2 + y^2 + 1) + 0i$

(D) $(x^2 - y^2 - 1) + 3i$

71. If $f(z) = z = x + iy$ is an analytic function then $\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} \right) |f(z)|^2$ is:

(A) $|f'(z)|^2$

(B) $2|f'(z)|^2$

(C) $3|f'(z)|^2$

(D) $4|f'(z)|^2$

72. If $f(z)$ be a function which is analytic inside and on a simple closed curve C and z_0 be any point

in the interior of C , then $\int_C \frac{f(z)}{z-z_0} dz$ is:

- (A) $\pi i f(z_0)$ (B) $2\pi i f(z_0)$
 (C) $3\pi i f(z_0)$ (D) $4\pi i f(z_0)$

73. Value of $\text{Arg}(\pi)$ is:

- (A) π (B) 0
 (C) $-\pi$ (D) $\frac{\pi}{2}$

74. Let $f: C \rightarrow C$ such that $f(z) = \sin z$ for all $z \in C$. Then :

- (A) $-1 \leq \sin z \leq 1$ (B) $\sin z$ is bounded
 (C) $\sin z$ is constant (D) $\sin z$ is not bounded in C

75. Let $\rho: \mathbb{R}^2 \times \mathbb{R}^2 \rightarrow \mathbb{R}$, \mathbb{R} is the set of real numbers. Then, the taxi-cab metric is

- (A) $\rho(x, y) = \max\{|x_1 - x_2|, |y_1 - y_2|\}$
 (B) $\rho(x, y) = \min\{1, d(x, y)\}$, d is a metric on \mathbb{R}
 (C) $\rho(x, y) = |x_1 - x_2| + |y_1 - y_2|$
 (D) $\rho(x, y) = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$

76. For the ideal $I = \langle x^2 + 1 \rangle$ of $Z[x]$, which one of the following is true?

- (A) I is a prime ideal, but not a maximal ideal.
 (B) I is a maximal ideal, but not a prime ideal.
 (C) I is both a prime and a maximal ideal.
 (D) None of the above.

77. Which one of the following rings is not a field?

- (A) $\frac{R[x]}{\langle x^2 + 1 \rangle}$ (B) $\frac{Q[x]}{\langle x^2 + 1 \rangle}$
 (C) $\frac{Z_2[x]}{\langle x^2 + 1 \rangle}$ (D) None of these

78. Let $R = \mathbb{Z} \times \mathbb{Z} \times \mathbb{Z}$ and $I = \mathbb{Z} \times \mathbb{Z} \times \{0\}$. Then which of the following statement is correct?
- (A) I is a maximal ideal but not a prime ideal of R .
 (B) I is a prime ideal but not a maximal ideal of R .
 (C) I is both maximal ideal as well as a prime ideal of R .
 (D) I is neither a maximal ideal nor a prime ideal of R .
79. Which one of the following ideals of the ring $\mathbb{Z}[i]$ of Gaussian integers is NOT maximal?
- (A) $\langle 1+i \rangle$ (B) $\langle 1-i \rangle$
 (C) $\langle 2+i \rangle$ (D) $\langle 3+i \rangle$
80. The number of maximal ideals in \mathbb{Z}_{27} is
- (A) 0 (B) 1
 (C) 2 (D) 3
81. If the quadrature formula $\int_0^2 xf(x)dx \approx af(0) + bf(1) + cf(2)$ is exact for all polynomials of degree ≤ 2 , then the value of $2b - c$ is _____.
- (A) $\frac{8}{3}$ (B) 2
 (C) $\frac{4}{3}$ (D) $\frac{2}{3}$
82. The Newton-Raphson formula for finding the cube root of N is _____.
- (A) $\frac{2x_n^3 + N}{3x_n^2}$ (B) $\frac{2x_n^3 - N}{3x_n^2}$
 (C) $\frac{2x_n^3 + N^2}{3x_n^2}$ (D) $\frac{2x_n^3 - N^2}{3x_n^2}$

87. Using the following values of x and $f(x)$:

x	0	0.5	1	1.5
$f(x)$	1	α	0	$-\frac{5}{4}$

If the integral $\int_0^{1.5} f(t)dt$, evaluated by Trapezoidal rule is $\frac{5}{16}$, then the value of α is _____.

(A) $\frac{19}{24}$

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

(C) $\frac{5}{4}$

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

88. Exact value of the definite integral: $\int_a^b f(x)dx$ by using Simpson's rule

(A) is obtained when f is a polynomial of degree 3.

(B) is obtained when f is a polynomial of degree 4.

(C) is obtained when f is a polynomial of degree 5.

(D) cannot be obtained for any polynomial.

89. For the following table:

x	$f(x)$
0	41
1	43
2	47
3	53
4	61
5	71

The degree of the interpolating polynomial $f(x)$ is:

(A) 6

(B) 3

(C) 5

(D) 2

90. $P \vee (P \rightarrow Q) \vee \{ \sim P \vee Q \}$ is a :
- (A) Tautology
 (B) Contradiction
 (C) Contingency
 (D) Satisfiable but invalid
91. The length of a Hamiltonian path (if it exists) in a connected graph of n vertices is :
- (A) n (B) $n + 1$
 (C) $n - 1$ (D) $\frac{n(n+1)}{2}$
92. The number of spanning trees in a complete graph with 5 vertices is :
- (A) 125 (B) 25
 (C) 625 (D) 120
93. By the principle of mathematical induction, $1^2 + 3^2 + 5^2 + \dots + (2n - 1)^2$ is:
- (A) $\frac{n(n+1)(2n+1)}{6}$ (B) $\frac{n(2n-1)(2n+1)}{3}$
 (C) $\frac{n(2n-1)(2n+1)}{6}$ (D) $\frac{n(n+1)(2n+1)}{3}$
94. If G be a connected planar simple graph with ' e ' edges and ' v ' vertices, then the number of regions ' r ' is:
- (A) $-e + v - 2$ (B) $e + v - 2$
 (C) $e - v + 2$ (D) $e + v + 2$
95. Order of convergence of secant method is
- (A) $\frac{1+\sqrt{5}}{2}$ (B) $\frac{1-\sqrt{5}}{2}$
 (C) 1 (D) 2

96. The PDE $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ is called
- (A) Wave Equation (B) Heat Equation
(C) Laplace's Equation (D) None of These
97. Curve whose equation given by $y^2 - 8x - 6y - 23 = 0$ is
- (A) ellipse (B) hyperbola
(C) parabola (D) circle
98. The new co-ordinate of the point (2,4) if the co-ordinate axis is rotated by $\theta = \frac{\pi}{2}$ (anti clock-wise) is
- (A) (4, 2) (B) (4, -2)
(C) (-2, 4) (D) (-4, 2)
99. The rectangular co-ordinate of the point with cylindrical co-ordinates $(r, \theta, z) = \left(4, \frac{\pi}{3}, -3\right)$ is
- (A) $(2, 2\sqrt{3}, -3)$ (B) $(2, -2\sqrt{3}, -3)$
(C) $(-2, -2\sqrt{3}, -3)$ (D) $(-2, -2\sqrt{3}, 3)$
100. The Curl of $F = x^2 y \hat{i} + 2y^3 z \hat{j} + 3z \hat{k}$ is
- (A) $-2y^3 \hat{i} - x^2 \hat{k}$ (B) $2y^3 \hat{i} + x^2 \hat{k}$
(C) $-2y^3 \hat{i} + x^2 \hat{k}$ (D) $-2y^3 \hat{i} - x^2 \hat{k}$