

MATHEMATICS PG

1. If $f : R \rightarrow R$ is not a constant function satisfying the property $f(x+y) = f(x)f(y)$, then $f(0)$ is
 - (A) 0
 - (B) 1
 - (C) 2
 - (D) 3

2. The largest interval lying in $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$ in which the function $f(x) = 3^{-x^2} + \arccos\left(\left(\frac{x}{2}\right) - 1\right) + \log \cos x$ is defined, is
 - (A) $[0, \pi]$
 - (B) $\left[-\left(\frac{\pi}{2}\right), \left(\frac{\pi}{2}\right)\right]$
 - (C) $\left[0, \left(\frac{\pi}{2}\right)\right]$
 - (D) $\left[-\left(\frac{\pi}{2}\right), 0\right]$

3. If $f(x)$ is a differentiable function such that $f(x) \leq f(3)$ for $1 \leq x \leq 3$, then
 - (A) $f'(3) = 0$
 - (B) $f'(3) = f(3)$
 - (C) $f'(3) = 3$
 - (D) $f'(3)$ does not exist

4. Area lying between the parabola $y^2 = 4ax$ and its latus rectum is
 - (A) $\left(\frac{8}{3}\right)a^2$
 - (B) $\left(\frac{8}{3}\right)a$
 - (C) $\left(\frac{4}{3}\right)a$
 - (D) $\left(\frac{4}{3}\right)a^2$

5. Area bounded by the curves $x = 1$, $x = 3$, $xy = 1$ and x axis is
- (A) $\log 2$
(B) $\log 3$
(C) $\log 4$
(D) $\log 5$
6. Area bounded by the curve $y = \log x$, $y = 0$ and $x = e$ is given by
- (A) e
(B) $\frac{e}{2}$
(C) 1
(D) 2
7. Equations of the curve passing through $(1, 1)$ and satisfying the differential equation $\frac{dy}{dx} = \frac{2y}{x}$, $(x > 0, y > 0)$ is given by
- (A) $x^2 = y$
(B) $x = y^2$
(C) $x = 2y$
(D) $y = 2x$
8. The differential equation of the family of curves $y = e^x(A \cos x + B \sin x)$, where A and B are arbitrary constants is
- (A) $\frac{d^2 y}{dx^2} - 2 \frac{dy}{dx} + 2y = 0$
(B) $\frac{d^2 y}{dx^2} + 2 \frac{dy}{dx} - 2y = 0$
(C) $\frac{d^2 y}{dx^2} + \left(\frac{dy}{dx}\right)^2 + y = 0$
(D) $\frac{d^2 y}{dx^2} - 7 \frac{dy}{dx} + 2y = 0$

9. Projection of the vector $3i + 3j - 2k$ on the vector $i + 2j + 3k$ is
- (A) $\frac{2}{\sqrt{14}}$
(B) $\frac{1}{\sqrt{14}}$
(C) $\frac{3}{\sqrt{14}}$
(D) $\frac{4}{\sqrt{14}}$
10. If $a + b + c = 0$, $|a| = 3$, $|b| = 5$, $|c| = 7$ then the angle between a and b is
- (A) $\pi/6$
(B) $2\pi/3$
(C) $5\pi/3$
(D) $\pi/3$
11. The vector $2i + j - k$ is perpendicular to $i - 4j + ak$ then a is equal to
- (A) 0
(B) -1
(C) -2
(D) -3
12. Let a and b be two unit vectors and α is the angle between them. If the vector $a + b$ is a unit vector, then the angle
- (A) $\alpha = \pi/4$
(B) $\alpha = \pi/3$
(C) $\alpha = 2\pi/3$
(D) $\alpha = \pi/2$
13. The work done by the force $F = 2i - 3j + 2k$ in moving a particle from $(3, 4, 5)$ to $(1, 2, 3)$ is
- (A) 0
(B) $\frac{3}{2}$
(C) -4
(D) -2

14. The area of the triangle whose two sides are $4i - j + k$ and $3i + j - k$ is
- (A) $7\sqrt{2}$
(B) $14\sqrt{2}$
(C) $\frac{14}{\sqrt{2}}$
(D) $\frac{7}{\sqrt{2}}$
15. The area of the parallelogram having diagonals $3i + j - 2k$ and $i - 3j + 4k$ is
- (A) $10\sqrt{3}$
(B) $5\sqrt{3}$
(C) 8
(D) 4
16. $[a, b, a \times b]$ is equal to
- (A) $|a \times b|$
(B) $|a \times b|^2$
(C) $|a \cdot b|$
(D) $|a||b|$
17. The volume of the parallelepiped whose sides are $OA = 2i - 3j$, $OB = i + j - k$ and $OC = 3i - k$ is
- (A) $\frac{4}{13}$
(B) 7
(C) $\frac{2}{7}$
(D) 2
18. $(a - b) \times (a + b) =$
- (A) 0
(B) $a \times b$
(C) $2(a \times b)$
(D) $|a|^2 + |b|^2$

19. The number of non-zero terms in the expansion of $(1+3\sqrt{2x})^9 + (1-3\sqrt{2x})^9$ is
- (A) 9
(B) 0
(C) 5
(D) 10
20. The number of terms in the expansion of $(x+y+z)^{10}$ is
- (A) 11
(B) 33
(C) 66
(D) 88
21. If the coefficient of x^7 and x^8 in $\left(2+\frac{x}{3}\right)^n$ are equal then n is
- (A) 56
(B) 55
(C) 45
(D) 15
22. In the expansion of $(1+x)^{50}$, the sum of the coefficients of odd powers of x is
- (A) 0
(B) 2^{49}
(C) 2^{50}
(D) 2^{51}
23. The sum of the coefficients in $(x+2y+z)^{10}$ is
- (A) 2^{10}
(B) 3^{10}
(C) 1
(D) None of the above
24. In the expansion of $(1+ax)^n$, the first three terms are $1+12x+64x^2$, then $n =$
- (A) 9
(B) 12
(C) 6
(D) 10

25. The Binomial expansion of $(1+x)^{-4}$ is valid only when

- (A) $x \leq 1$
- (B) $x < 1$
- (C) $-1 \leq x \leq 1$
- (D) $-1 < x < 1$

26. ${}^1C_1 + {}^2C_2 + {}^3C_3 + \dots + {}^nC_n$ is equal to

- (A) $n2^n$
- (B) $n2^{n-1}$
- (C) $(n+1)2^n$
- (D) None of the above

27. The number of vectors of unit length perpendicular to the vector $a = (1, 1, 0)$ and $b = (0, 1, 1)$ is

- (A) 1
- (B) 2
- (C) 3
- (D) 4

28. The greatest integer less than or equal to $(\sqrt{3} + 1)^6$ is

- (A) 208
- (B) 104
- (C) 412
- (D) None of the above

29. The number $(11^{10} - 1)$ is divisible by

- (A) 5
- (B) 11
- (C) 52
- (D) 108

30. For every positive integer $n > 1$, $(8^n - 8n + 1)$ is divisible by

- (A) 7
- (B) 2
- (C) 343
- (D) None of the above

31. If $x^3 > x^2 + x + 2$ then
- (A) $x < 2$
 - (B) $x \geq 2$
 - (C) $x > 2$
 - (D) $x \leq 2$
32. $4^{\sin^2 x} + 4^{\cos^2 x}$ is
- (A) ≤ 4
 - (B) ≥ 4
 - (C) ≤ 2
 - (D) ≥ 2
33. The largest interval for which $x^{12} - x^9 + x^4 - x + 1 > 0$ is
- (A) $-4 < x \leq 0$
 - (B) $0 < x < 1$
 - (C) $-100 < x < 100$
 - (D) $0 < x < \infty$
34. The greatest value of x in order that $6x^2 + 10 \geq x^3 + 13x$ is
- (A) 1
 - (B) 2
 - (C) 3
 - (D) 4
35. The number of ways, in which a student can choose 4 courses out of 9 courses, when 2 courses are compulsory, is
- (A) 36
 - (B) 35
 - (C) 126
 - (D) 256
36. The number of different four digit numbers that can be formed with the digits 2, 3, 4, 5, 7 using each digit only once is
- (A) 120
 - (B) 96
 - (C) 24
 - (D) 12

37. The number of diagonals that can be drawn by joining the vertices of an octagon is
- (A) 28
 - (B) 48
 - (C) 20
 - (D) 10
38. The sum of the digits in the unit place of all the numbers formed with the help of 3, 4, 5, 6 taken all at a time is
- (A) 432
 - (B) 108
 - (C) 36
 - (D) 18
39. The number of 4 digit numbers that can be formed by the digits 3, 4, 5, 6, 7, 8, 0, no digit is being repeated, is
- (A) 720
 - (B) 840
 - (C) 280
 - (D) 120
40. The number of positive integers greater than 6000 and less than 7000 which are divisible by 5, using the digits 0, 1, 2, ..., 9, no digit being repeated, is
- (A) 56
 - (B) 112
 - (C) 28
 - (D) None of the above
41. A polygon has 60 diagonals, the number of its sides is
- (A) 10
 - (B) 11
 - (C) 12
 - (D) None of the above
42. The number of parallelograms that can be formed from a set of four parallel lines intersecting another set of three parallel lines is
- (A) 6
 - (B) 18
 - (C) 12
 - (D) 9

43. In how many ways can 5 red and 4 white balls be drawn from a bag containing 10 red and 8 white balls?
- (A) ${}^8C_5 {}^{10}C_4$
(B) ${}^{10}C_5 {}^8C_4$
(C) ${}^{18}C_9$
(D) None of the above
44. Four dice are rolled, the number of possible outcomes in which at least one die shows 2, is
- (A) 1296
(B) 625
(C) 671
(D) 751
45. The sum of proper divisors of 72 (1 and 72 are excluded) is equal to
- (A) 195
(B) 122
(C) 194
(D) None of the above
46. The average of first n natural numbers is
- (A) $\frac{2n+1}{2}$
(B) $n - \frac{1}{2}$
(C) $\frac{n+1}{2}$
(D) $\frac{n-1}{2}$
47. The arithmetic mean of 9 observations is 100 and that of 6 is 80. Then the combined mean of all the 15 observations will be
- (A) 100
(B) 80
(C) 90
(D) 92

48. If $f : R \rightarrow R$ and $g : R \rightarrow R$ are uniformly continuous, then is uniform continuous.

- (A) $f + g$
- (B) $\frac{f}{g}$
- (C) $f - g$
- (D) None of the above

49. The set of all real number R with respect to usual topology is a

- (A) disconnected set
- (B) connected set
- (C) compact set
- (D) closed set

50. $x_n \rightarrow P \Leftrightarrow d(x_n, P) \rightarrow \dots\dots\dots$

- (A) ∞
- (B) $-\infty$
- (C) 0
- (D) 1

51. The sum of the eigen values of the matrix $\begin{pmatrix} 3 & -4 & 4 \\ 1 & -2 & 4 \\ 1 & -1 & 3 \end{pmatrix}$ is

- (A) 0
- (B) 4
- (C) 2
- (D) -14

52. $\binom{n}{0} + \binom{n}{1}x + \binom{n}{2}x^2 + \dots + \binom{n}{n}x^n =$

- (A) $2^n x^n$
- (B) $(1+x)^n$
- (C) $(1-x)^n$
- (D) $(1-x)^{-n}$

53. For two sets A and B , $|A| + |B| =$

- (A) $|A \cup B| - |A \cap B|$
- (B) $|A \cup B| + |A \cap B|$
- (C) $|A \cap B| - |A \cup B|$
- (D) $|A| + |B| - |A \cap B|$

54. Consider the vector space $V_3(R)$ where R is the field of real numbers. Let S be the subspace of $V_3(R)$ spanned by $\{(1,1,1)\}$ and let T be the subspace spanned by $\{(1,2,1)\}$. Then $\dim(S \cap T)$ and $\dim(S + T)$ are respectively

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

55. $\{1, i\}$ is a basis for the vector space

- (A) C over R
- (B) R over C
- (C) $R \times R$ over C
- (D) None of the above

56. In $R[x]$ let $S = \{1, x, x^2, x^3\}$. Then $L(S)$ is

- (A) $R[x]$
- (B) $V_3(R)$
- (C) S
- (D) Set of all polynomials of degree ≤ 3

57. The Characteristic polynomial of $A = \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ is

- (A) x^2
- (B) $x^2 - 1$
- (C) $1 - x^2$
- (D) $x - 1$

58. The norm of the vector $(1, 2, 3)$ in $V_3(R)$ with standard Inner product is

- (A) 6
- (B) 14
- (C) $\sqrt{14}$
- (D) 1

59. If $f(x) = 0$ has two equal roots, then there is a common root for

- (A) $f(x) = 0$ and $f'(x) = 0$
- (B) $f(x) = 0$ and $f''(x) = 0$
- (C) $f'(x) = 0$ and $f''(x) = 0$
- (D) None of the above

60. If a, b and c are the real numbers, then which of the following is not true?

- (A) $|a+b| \leq |a| + |b|$
- (B) $|a-b| \leq |a| + |b|$
- (C) $|a-b| \leq |a| - |b|$
- (D) $|a-c| \leq |a-b| + |b-c|$

61. For which value of k does the following pair of equation yields unique solution for x such that the solution is positive?

$$x^2 - y^2 = 0$$

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

- (A) 2
- (B) 0
- (C) $\sqrt{2}$
- (D) $-\sqrt{2}$

62. If the length of the sides of a triangle are 3, 5 and 7 then the largest angle of the triangle is

- (A) $\frac{\pi}{2}$
- (B) $\frac{5\pi}{6}$
- (C) $\frac{2\pi}{3}$
- (D) $\frac{3\pi}{4}$

63. If y is expressed in terms of a variable x as $y = f(x)$, then y is called

- (A) explicit function
- (B) implicit function
- (C) linear function
- (D) identity function

64. Z is a group under

- (A) Subtraction
- (B) Division
- (C) Multiplication
- (D) Addition

65. If f is a bijective function, then $f^{-1}(f(x)) =$

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

66. Extraction of a cube root of a given number is

- (A) binary operation
- (B) relation
- (C) unary operation
- (D) relation in some set

67. Matrix A will not be transformed into an identity matrix if matrix is
- (A) singular
 - (B) non-singular
 - (C) identified
 - (D) unidentified
68. The system of linear equations $(4d-1)x + y - z = 0, -y + z = 0, (4d-1)z = 0$ has a non-trivial solution, if d equals
- (A) $\frac{1}{2}$
 - (B) $\frac{1}{4}$
 - (C) $\frac{3}{4}$
 - (D) 1
69. The function $f(x) = x^3 - 6x^2 + 9x + 25$ has
- (A) a maxima at $x = 1$ and a minima at $x = 3$
 - (B) a maxima at $x = 3$ and a minima at $x = 1$
 - (C) no maxima, but a minima at $x = 1$
 - (D) a maxima at $x = 1$, but no minima
70. Let I_n be the identity matrix of odd order n , then
- (A) $\text{adj } I_n = nI_n$
 - (B) $\text{adj } I_n = 0$
 - (C) $\text{adj } I_n = I_n$
 - (D) $n = 1$
71. The derivative of $f(x) = |x|$ at $x = 0$ is
- (A) 1
 - (B) -1
 - (C) 0
 - (D) does not exist

72. Limit of $f(x) = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \dots$ as x approaches $\frac{\pi}{2}$ is
- (A) $\frac{2\pi}{3}$
(B) $\frac{\pi}{2}$
(C) $\frac{\pi}{3}$
(D) 1
73. The value of integral $\int_{-2}^2 \frac{dx}{x^2}$
- (A) 0
(B) 0.25
(C) -1
(D) ∞
74. Area bounded by the parabola $2y = x^2$ and the line $x = y - 4$ is equal to
- (A) 6
(B) 18
(C) ∞
(D) None of the above
75. Directional derivative of $f(x, y, z) = x^2 + y^2 + z^2$ at the point (1, 1, 1) in the direction $i - k$ is
- (A) 0
(B) 1
(C) $\sqrt{2}$
(D) $2\sqrt{49}$
76. The convergence of which of the following method is sensitive to starting value?
- (A) False position
(B) Gauss seidal method
(C) Newton- Raphson method
(D) All of the above

77. If $x - y = 1$, then $x^3 - y^3 - 3xy$ equals
- (A) 0
 - (B) 1
 - (C) 2
 - (D) $x^2 - y^2$
78. Let A be the set of all non-singular matrices over real numbers and let $*$ be the matrix multiplication operator. Then
- (A) A is closed under $*$ but $\langle A, * \rangle$ is not a semi group
 - (B) $\langle A, * \rangle$ is a semi group but not a monoid
 - (C) $\langle A, * \rangle$ is a monoid but not a group
 - (D) $\langle A, * \rangle$ is a group but not an abelian group
79. Which is not true about number zero?
- (A) Even
 - (B) Positive
 - (C) Additive identity
 - (D) Additive inverse of zero
80. Infeasibility means that the number of solutions to the linear programming models that satisfies all constraints is
- (A) at least 1
 - (B) 0
 - (C) an infinite number
 - (D) at least 2
81. A constraint that does not affect the feasible region is a
- (A) non-negativity constraint
 - (B) redundant constraint
 - (C) slack constraint
 - (D) standard constraint
82. The variables whose coefficient vectors are unit vectors are called
- (A) basic variables
 - (B) unit variables
 - (C) non basic variables
 - (D) None of the above

83. If in an LPP the value of a variable can be made infinity large without violating the constraints, then the solution is
- (A) infeasible solution
 - (B) alternative solution
 - (C) unbounded solution
 - (D) None of the above
84. A set A is said to be countable if there exists a function $f: A \rightarrow N$ such that
- (A) f is bijective
 - (B) f is surjective
 - (C) f is identity map
 - (D) None of the above
85. A convergent sequence has only limit(s).
- (A) one
 - (B) two
 - (C) three
 - (D) None of the above
86. A sequence of real numbers is Cauchy if and only if
- (A) it is bounded
 - (B) it is convergent
 - (C) it is positive term sequence
 - (D) it is convergent but not bounded
87. A series $\sum_{1}^{\infty} \frac{1}{x^p}$ is convergent if
- (A) $p \geq 1$
 - (B) $p \leq 1$
 - (C) $p > 1$
 - (D) $p < 1$
88. Every Cauchy sequence has a
- (A) convergent subsequence
 - (B) increasing subsequence
 - (C) decreasing subsequence
 - (D) positive subsequence

89. Laplace transform is a
- (A) linear transform
 - (B) binomial transform
 - (C) canonical transform
 - (D) None of the above
90. A system of two equations that has no values to satisfy both equations is called
- (A) consistent system
 - (B) inconsistent system
 - (C) solution system
 - (D) constant system
91. The graph of the function $y = f(x)$ is symmetrical about the line $x = 2$, then
- (A) $f(x+2) = f(x-2)$
 - (B) $f(2+x) = f(2-x)$
 - (C) $f(x) = f(-x)$
 - (D) $f(x) = -f(-x)$
92. Network models of projects have advantage in terms of
- (A) Planning only
 - (B) Scheduling only
 - (C) Controlling only
 - (D) All of the above
93. The average marks of boys in a class is 52 and that of girls is 42. The average marks of boys and girls combined is 50. The percentage of boys in the class is
- (A) 40%
 - (B) 20%
 - (C) 80%
 - (D) 60%
94. The order and degree of the differential equation $\sqrt{\sin x}(dx + dy) = \sqrt{\cos x}(dx - dy)$ is
- (A) (1, 2)
 - (B) (2, 2)
 - (C) (1, 1)
 - (D) (2, 1)

95. The solution of the differential equation $ydx + (x - y^3)dy = 0$ is
- (A) $xy = \frac{1}{3}y^3 + c$
(B) $xy = y^4 + c$
(C) $y^4 = 4xy + c$
(D) $4y = y^3 + c$
96. If the points with position vectors $60\hat{i} + 3\hat{j}$, $40\hat{i} - 8\hat{j}$ and $a\hat{i} - 52\hat{j}$ are collinear, then a is equal to
- (A) -40
(B) -20
(C) 20
(D) 40
97. The centre of the circle given by $\vec{r} \cdot (\hat{i} + 2\hat{j} + 2\hat{k}) = 15$ and $\left| \vec{r} - (\hat{j} + 2\hat{k}) \right| = 4$ is
- (A) $(0, 1, 2)$
(B) $(1, 3, 4)$
(C) $(-1, 3, 4)$
(D) $(0, -1, 4)$
98. If the projection of the vector $\vec{a}$ on $\vec{b}$ is $\left| \vec{a} \times \vec{b} \right|$ and if $3\vec{b} = \hat{i} + \hat{j} + \hat{k}$, then the angle between $\vec{a}$ and $\vec{b}$ is
- (A) $\frac{\pi}{3}$
(B) $\frac{\pi}{4}$
(C) $\frac{\pi}{6}$
(D) $\frac{\pi}{2}$

99. The line joining the points $6\vec{a} - 4\vec{b} + 4\vec{c}$, $-4\vec{c}$ and the line joining the points $-\vec{a} - 2\vec{b} - 3\vec{c}$, $\vec{a} + 2\vec{b} - 5\vec{c}$ intersect at

- (A) $-4\vec{a}$
- (B) $4\vec{a} - 4\vec{b} - 4\vec{c}$
- (C) $4\vec{c}$
- (D) $-4\vec{c}$

100. If $\vec{b}$ is a unit vector, then $(\vec{a} \cdot \vec{b})\vec{b} + \vec{b} \times (\vec{a} \times \vec{b})$ is

- (A) $|\vec{a}|^2 \vec{b}$
- (B) $|\vec{a} \cdot \vec{b}| \vec{a}$
- (C) $\vec{a}$
- (D) $\vec{b}$

101. The figure formed by the four points $\hat{i} + \hat{j} - \hat{k}$, $2\hat{i} + \hat{j}$, $5\hat{j} - 2\hat{k}$ and $\hat{k} - \hat{j}$ is

- (A) trapezium
- (B) rectangle
- (C) parallelogram
- (D) None of the above

102. The value of $\frac{(\vec{a} \times \vec{b})^2 + (\vec{a} \cdot \vec{b})^2}{2\vec{a}^2 \cdot \vec{b}^2}$ is

- (A) $\vec{a} \cdot \vec{b}$
- (B) 1
- (C) 0
- (D) $\frac{1}{2}$

103. Distance between two parallel planes $2x + y + 2z = 8$ and $4x + 2y + 4z + 5 = 0$ is

- (A) $\frac{7}{2}$
- (B) $\frac{13}{3}$
- (C) $\frac{13}{6}$
- (D) $\frac{7}{3}$

104. If the angle θ between the line $\frac{x+1}{1} = \frac{y-1}{2} = \frac{z-2}{2}$ and the plane $2x - y + \sqrt{\lambda}z + 4 = 0$ is such that $\sin \theta = \frac{1}{3}$, then the value of λ is

- (A) $-\frac{4}{3}$
- (B) $\frac{3}{4}$
- (C) $-\frac{3}{5}$
- (D) $\frac{5}{3}$

105. The plane $x + 2y - z = 4$ cuts the sphere $x^2 + y^2 + z^2 - x + z - 2 = 0$ in a circle of radius

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

106. The equation of the plane which is parallel to $x + 2y + 3z - 5 = 0$ and $x + 2y + 3z - 7 = 0$ and also at equidistant from the planes is

- (A) $x + 2y + 3z - 6 = 0$
- (B) $x + 2y + 3z - 1 = 0$
- (C) $x + 2y + 3z - 8 = 0$
- (D) $x + 2y + 3z - 3 = 0$

107. A variable plane moves so that sum of the reciprocals of its intercepts with the coordinate axes is $\frac{1}{2}$. Then, the plane passes through the point

(A) $\left(\frac{1}{2}, \frac{1}{2}, -\frac{1}{2}\right)$

(B) $(-1, 1, 1)$

(C) $(2, 2, 2)$

(D) $(0, 0, 0)$

108. The perimeter of the triangle with vertices at $(1, 0, 0)$, $(0, 1, 0)$ and $(0, 0, 1)$ is

(A) 3

(B) 2

(C) $2\sqrt{2}$

(D) $3\sqrt{2}$

109. The sequence $\{a_n\}$, where $a_n = \begin{cases} \frac{n}{2} & \text{if } n \text{ is even} \\ \frac{1-n}{2} & \text{if } n \text{ is odd} \end{cases}$ is

(A) bounded below but not from above

(B) bounded above but not from below

(C) unbounded both from below and above

(D) monotonic

110. $\lim_{n \rightarrow \infty} \left(\frac{\cos n}{n} \right)$ is

(A) -1

(B) 0

(C) 1

(D) ∞

111. If $x^3 + y^3 - 3axy = 0$, then $\frac{dy}{dx}$ equals

(A) $\frac{ay - x^2}{y^2 - ax}$

(B) $\frac{ay - x^2}{ay - y^2}$

(C) $\frac{x^2 + ay}{y^2 + ax}$

(D) $\frac{x^2 + ay}{ax - y^2}$

112. If $2x^2 - 3xy + y^2 + x + 2y - 8 = 0$, then $\frac{dy}{dx}$ is equal to

(A) $\frac{3y - 4x - 1}{2y - 3x + 2}$

(B) $\frac{3y + 4x + 1}{2y + 3x + 2}$

(C) $\frac{3y - 4x + 1}{2y - 3x - 2}$

(D) $\frac{3y - 4x + 1}{2y + 3x + 2}$

113. If $y = e^{ax} \sin bx$, then $\frac{d^2y}{dx^2} - 2a\frac{dy}{dx} + a^2y$ is equal to

(A) 0

(B) 1

(C) $-b^2y$

(D) $-by$

114. If $\int_0^a f(2a - x)dx = \mu$ and $\int_0^a f(x)dx = \lambda$, then $\int_0^{2a} f(x)dx$ equals

(A) $2\lambda - \mu$

(B) $\mu - \lambda$

(C) $\lambda - 2\mu$

(D) $2\lambda + \mu$

115. Area bounded by the curve $y^2 = 16x$ and line $y = mx$ is $\frac{2}{3}$, then m is equal to
- (A) 3
 - (B) 4
 - (C) 1
 - (D) 2
116. The area of the region bounded by $y^2 = 2x + 1$ and $x - y = 1$ is
- (A) $\frac{2}{3}$
 - (B) $\frac{4}{3}$
 - (C) $\frac{8}{3}$
 - (D) $\frac{16}{3}$
117. The area between the curve $y = 1 - |x|$ and the x -axis is equal to
- (A) 1 sq unit
 - (B) $\frac{1}{2}$ sq unit
 - (C) $\frac{1}{3}$ sq unit
 - (D) 2 sq unit
118. X is a non-negative valued continuous random variable with distribution function $F(\cdot)$. Define $Y = F(X)$. Then Y has
- (A) discrete uniform distribution
 - (B) uniform distribution on the interval $[a, b]$ with $b > a$ and both positive
 - (C) uniform distribution on $[0, 1]$
 - (D) None of the above
119. The function $f(x) = |x|$ for $x \in \mathbb{R}$ is
- (A) continuous and differentiable at $x = 0$
 - (B) continuous but not differentiable at $x = 0$
 - (C) discontinuous at $x = 0$
 - (D) discontinuous and differentiable at $x = 0$

120. Let $T_1(z) = \frac{1}{r}e^{i\theta}$ and $T_2(z) = \frac{1}{r}e^{-i\theta}$ for all $z \in \mathbb{C}$. Then $(T_2 \circ T_1)(z) =$

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

121. If the point $P(4,3)$ is shifted by a distance $\sqrt{2}$ unit parallel to the line $y = x$, then the coordinates of P in new position is

- (A) $(-5, -4)$
- (B) $(5 + \sqrt{2}, 4 + \sqrt{2})$
- (C) $(5 - \sqrt{2}, 4 - \sqrt{2})$
- (D) $(5, 4)$

122. The n^{th} term of the sequence $\left\{1, \frac{5}{2}, \frac{5}{3}, \frac{9}{4}, \frac{9}{5}, \dots\right\}$ is

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

123. If H and K are subgroups of a group G , then HK is a subgroup of G if and only if

- (A) $H \cap K \neq \phi$
- (B) $H \cap K = \phi$
- (C) $HK = KH$
- (D) $HK \neq KH$

124. The vectors $(1, 1, 0)$, $(3, 1, 3)$ and $(5, 3, 3)$ in $\mathbb{R}^3$ are
- (A) linearly independent over $\mathbb{R}$
 - (B) linearly dependent over $\mathbb{R}$
 - (C) basis of $\mathbb{R}^3$
 - (D) orthonormal vectors
125. X is a real valued random with $\text{var}(X) = 0$. Then the random variable takes
- (A) any one of the real numbers with probability one and remaining real numbers with probability zero
 - (B) any purely complex number alone with probability 1
 - (C) the number zero alone with probability one
 - (D) None of the above
126. X is a random variable with expected value $E(X) = 0$. Then its variance is
- (A) necessarily zero
 - (B) strictly negative
 - (C) not defined
 - (D) None of the above
127. Expectation $E(X)$ of a continuous non-negative valued random variable X , with distribution function $F(\cdot)$, is
- (A) $\sum_{n=1}^{\infty} n \text{prob}(X = n)$
 - (B) $\int_{-\infty}^0 -F(x)dx$
 - (C) $\int_0^{\infty} [1 - F(x)]dx$
 - (D) None of the above
128. X and Y are two dependent random variables. Then $E[E(X|Y)]$ is
- (A) $E(Y)$
 - (B) $E(X|Y)$
 - (C) $E(X.Y)$
 - (D) $E(X)$

129. X is a binomial random variable, that is X is $B(n, p)$. Y is a Poisson random variable, independent of X , having expected value θ , that is $P(Y = k) = \frac{(e^{-\theta} \theta^k)}{k!}$.

Then $P(X = r, Y = m)$ for non-negative integers r and m , is

- (A) $P(X = r).P(Y = m)$
- (B) $P(X \leq r).P(Y = m)$
- (C) $P(X > r).P(Y \geq m)$
- (D) None of the above

130. $X_1, X_2, \dots, X_n$ are n independent but non-identically distributed random variables. Then the characteristic function of their sum

- (A) is not defined
- (B) exists but takes value infinity
- (C) is the product of their characteristic functions
- (D) is the sum of their characteristic functions

131. The domain of convergence for $1 + x + x^2 + \dots$ is

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

132. The matrix $\begin{bmatrix} ai & 0 \\ 0 & -ai \end{bmatrix}$ is

- (A) a Hermitian matrix
- (B) a skew-Hermitian matrix
- (C) a skew-symmetric matrix
- (D) not in the class of matrices given (A) to (C) above

133. If $|z| = |z - 1|$, then

- (A) $\operatorname{Re}(z) = 1$
- (B) $\operatorname{Re}(z) = \frac{1}{2}$
- (C) $\operatorname{Im}(z) = 1$
- (D) $\operatorname{Im}(z) = \frac{1}{2}$

134. The locus of the complex number satisfying $\arg \frac{z-1}{z+1} = \frac{\pi}{3}$ is
- (A) straight line
 - (B) circle
 - (C) parabola
 - (D) hyperbola
135. Let $G = \{1, -1, i, -i\}$ be the multiplicative group. Then the order of $-i$ is
- (A) one
 - (B) two
 - (C) three
 - (D) four
136. The set of all even integers is
- (A) a field
 - (B) a skew field
 - (C) a commutative ring
 - (D) None of the above
137. The number of arbitrary constants in a differential equation of order m and degree n is p . Then
- (A) $p = n$
 - (B) $p < n$
 - (C) $p = m$
 - (D) $p < m$
138. The solution of $(D^2 + D - 2)y = 0$ is
- (A) $y = c_1 e^{-2x} + c_2 e^{-x} + c_3$
 - (B) $y = c e^{-2x}$
 - (C) $y = c_1 e^{-2x} + c_2 e^x$
 - (D) $y = c_1 e^{-3x} + c_2 e^{-x}$
139. The equation $ydx + xdy = 0$ is
- (A) a partial differential equation
 - (B) an exact differential equation
 - (C) not an exact differential equation
 - (D) an equation of straight line

140. The mean and variance of Poisson distribution are same. This statement is
- (A) always true
 - (B) never true
 - (C) sometimes true
 - (D) irrelevant to Poisson distribution
141. The set of all real numbers x such that $\|3 - x| - |x + 2|\| = 5$ is
- (A) $[3, \infty)$
 - (B) $(-\infty, -2)$
 - (C) $(-\infty, -2] \cup [3, \infty)$
 - (D) $(-\infty, -3) \cup [2, \infty)$
142. Let $f : \mathbb{R} \rightarrow \mathbb{R}$ be a function defined by $f(x) = ax + b$ for $a, b \in \mathbb{R}$. Then $f \circ f = \text{identity}$ if and only if
- (A) $a = 1$
 - (B) $b = 0$
 - (C) $a = 2, b = -1$
 - (D) $a \pm 1, b = 0$
143. Which of the following is not a metric on $\mathbb{R}$?
- (A) $d(x, y) = |x - y|$
 - (B) $d(x, y) = \frac{|x - y|}{1 + |x - y|}$
 - (C) $d(x, y) = (x - y)^2$
 - (D) None of the above
144. Three identical dice are rolled. The probability that the same number will appear on each of them is
- (A) $\frac{1}{6}$
 - (B) $\frac{1}{18}$
 - (C) $\frac{1}{36}$
 - (D) $\frac{1}{216}$

145. Which of the following sets is uncountable?

- (A) $\mathbb{Q}$
- (B) $\mathbb{Q} + \sqrt{2}\mathbb{Q}$
- (C) $\{x : x \text{ is an irrational and } 0 < x < 1\}$
- (D) $\left\{m + \frac{1}{n} \mid m, n \in \mathbb{Q}_+\right\}$

146. In the set of all circles in planes, the relations $C_1 \sim C_2 \Leftrightarrow C_1$ and C_2 have exactly two common points is

- (A) reflexive
- (B) symmetric
- (C) transitive
- (D) antisymmetric

147. The locus of the point z satisfying the condition $\operatorname{Im}\left(\frac{z-z_1}{z-z_2}\right) = 0$ where, $z_1 \neq z_2$ is

- (A) a circle
- (B) interior of a circle
- (C) a straight line
- (D) a point

148. If $\cos \theta + i \sin \theta = x$, then the value of $x^n + \frac{1}{x^n}$ is

- (A) $2 \cos^2 n\theta$
- (B) $2 \sin^2 n\theta$
- (C) $2i \sin n\theta$
- (D) $2 \cos n\theta$

149. Let $E = [0, 1)$ and let E^0 denote the interior of E and $\bar{E}$ denote the closure of E . Then

- (A) $E^0 = [0, 1)$ and $\bar{E} = [0, 1]$
- (B) $E^0 = [0, 1] = \bar{E}$
- (C) $E^0 = (0, 1)$ and $\bar{E} = [0, 1]$
- (D) $E^0 = (0, 1)$ and $\bar{E} = [0, 1]$

150. If C is the unit circle $|z|=1$ then $\int_C e^z \sin z dz =$

- (A) $2\pi i$
- (B) $-2\pi i$
- (C) 0
- (D) 1

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ANSWER KEY**Subject Name: 612 MATHEMATICS**

SI No.	Key	SI No.	Key	SI No.	Key	SI No.	Key	SI No.	Key
1	B	31	C	61	C	91	B	121	D
2	C	32	B	62	C	92	D	122	B
3	A	33	D	63	A	93	C	123	C
4	A	34	B	64	D	94	C	124	B
5	B	35	B	65	D	95	C	125	A
6	C	36	A	66	A	96	A	126	D
7	A	37	C	67	A	97	B	127	C
8	A	38	B	68	B	98	A	128	D
9	A	39	A	69	A	99	D	129	A
10	D	40	D	70	C	100	C	130	C
11	C	41	D	71	D	101	D	131	A
12	C	42	B	72	D	102	D	132	D
13	D	43	B	73	C	103	A	133	B
14	D	44	C	74	B	104	D	134	B
15	B	45	D	75	A	105	C	135	D
16	B	46	C	76	C	106	A	136	D
17	B	47	D	77	B	107	C	137	C
18	C	48	A	78	D	108	D	138	C
19	C	49	B	79	B	109	C	139	B
20	C	50	C	80	B	110	B	140	A
21	B	51	B	81	B	111	A	141	C
22	B	52	B	82	A	112	A	142	D
23	D	53	B	83	C	113	C	143	D
24	A	54	C	84	A	114	B	144	C
25	D	55	A	85	A	115	B	145	C
26	D	56	D	86	B	116	D	146	B
27	B	57	B	87	C	117	B	147	C
28	D	58	C	88	A	118	C	148	D
29	A	59	A	89	A	119	B	149	D
30	A	60	C	90	B	120	A	150	C