MATHEMATICS

1. If α and β are the roots of $x^2-2x+4=0$, then $\alpha^n+\beta^n$ is -

(A) $2^{n+1}\cos\frac{2n\pi}{3}$.
(B) $2^{n+1}\cos\frac{n\pi}{6}$.
(C) $2^{n+1}\cos\frac{n\pi}{3}$.
(D) $2^{n+1}\cos\frac{3n\pi}{4}$.

2. $(Z_5, +_5)$ is -

(A) a non-abelian group.
(B) a semi group.
(C) an abelian group.
(D) not a group.

3. The angle of intersection of the curves $x^2=2y$ and $x^2+y^2=8$ at (2, 2) is -

(A) $\tan^{-1}(3)$.
(B) $\tan^{-1}(2)$.
(C) $\tan^{-1}(1)$.
(D) $\tan^{-1}(0,5)$.

4. The inverse of the matrix $\begin{bmatrix}3 & 0 & 0\\ 0 & -6 & 0\\ 0 & 0 & 3\end{bmatrix}$ is -

(A) $\frac{-1}{54}\begin{bmatrix}3 & 0 & 0\\ 0 & -6 & 0\\ 0 & 0 & 3\end{bmatrix}$.
(B) $\begin{bmatrix}1/3 & 0 & 0\\ 0 & -1/6 & 0\\ 0 & 0 & 1/3\end{bmatrix}$.
(C) $\begin{bmatrix}-18 & 0 & 0\\ 0 & 9 & 0\\ 0 & 0 & -18\end{bmatrix}$.
(D) $\begin{bmatrix}3 & 0 & 0\\ 0 & -6 & 0\\ 0 & 0 & 3\end{bmatrix}$.

5. $\begin{bmatrix}1 & 1 & 1\\ 2b & b-c-a & 2b\\ 2c & 2c & c-a-b\end{bmatrix}$ is equal to –

(A) 0.
(B) $(a+b+c)$.
(C) $(a+b+c)^2$.
(D) $(a+b+c)^3$.

6. The value of λ for which $\vec{i}+\vec{j}+\vec{k}$, $3\vec{i}+5\vec{j}-12\vec{k}$ and $5\vec{i}+7\vec{j}+\lambda\vec{k}$ are coplanar is -

(A) -10.
(B) -5.
(C) 0.
(D) 5.

7. The line $y-x-2=0$ touches the parabola $y^2=8x$ at -

(A) (2, 3).
(B) (2, 4).
(C) (8, 8).
(D) $\left(\frac{1}{8}, 1\right)$.

8. Distance between two complex numbers $(2+2i)$ and $(3+i)$ is -

(A) $\sqrt{2}$.
(B) 2.
(C) 1.
(D) $4\sqrt{2}$.

9. If $\frac{dy}{dx}=\infty$ at a point P on the curve $y=f(x)$, then -

(A) the normal at P to the curve $y=f(x)$ is parallel to x-axis.
(B) the normal at P to the curve $y=f(x)$ is parallel to y-axis.
(C) the tangent at P to the curve $y=f(x)$ is parallel to x-axis.
(D) the tangent at P to the curve $y=f(x)$ is parallel to y-axis.

10. The least value of n, for which $[(1+i)/(1-i)]^n=1$, is -

(A) 1.
(B) 2.
(C) 4.
(D) 6.

11. The function $\left[1-\frac{x^2}{2}-\cos x\right]$ is decreasing when x lies in -

(A) $(-\pi/2, 0)$.
(B) $(0, \pi/2)$.
(C) $(-\infty, 0)$.
(D) $(0, \infty)$.

12. Solution of $\sin^{-1}x\,dy+\frac{y}{\sqrt{1-x^2}}dx=0$ is -

(A) $\sin^{-1}x+y=c$.
(B) $y\sin^{-1}x=c$.
(C) $y=c\sin^{-1}x$.
(D) $y-\sin^{-1}x=c$.

13. Rank of a matrix is -

(A) not defined for a rectangular matrix.
(B) the order of highest non-vanishing minor.
(C) the largest among the number of rows and the number of columns.
(D) the lowest order non-vanishing minor.

14. In a gambling, one is paid Rs. 10 if he gets all heads and Rs. 8 for all tails. He loses Rs. 4 if he gets one or two heads, when three coins are tossed once. The expected gain is -

(A) -0.75 (B) -0.5
(C) 1 (D) 1.5

15. Given ω is a complex cube root of unity the value of the determinant $\begin{vmatrix} 1 & \omega & \omega^2 \\ \omega & \omega^2 & 1 \\ \omega^2 & 1 & \omega \end{vmatrix}$ is -

(A) 0. (B) ω.
(C) ω^2. (D) 1.

16. A random variable X has the following probability function

x	3	4	6	7
$P(x)$	k^2	k	$2k$	$3k^2$

. Then value of k is -

(A) -1. (B) 0.
(C) $\frac{1}{16}$. (D) $\frac{1}{4}$.

17. The work done by the force $\vec{F} = a\vec{i} + \vec{j} + \vec{k}$ in moving a particle from (1, 1, 1) to (2, 2, 2) along a straight line is 5 units. Then the value of a is -

(A) 2. (B) 3.
(C) 4. (D) 5.

18. The vectors $\vec{i} - 2\vec{j} + 3\vec{k}$ and $-3\vec{i} + 6\vec{j} - 9\vec{k}$ are -

(A) non-coplanar.
(B) parallel and have opposite directions.
(C) parallel and have same directions.
(D) perpendicular to each other.

19. If $f(x)=\begin{cases}\dfrac{x^5-32}{x-2}, & x\neq 2\\ k\quad , & x=2\end{cases}$ is continuous at $x=2$, then $k=$

(A) 16. (B) 80.
(C) 32. (D) 8.

20. The system AX = B have infinite number of solutions when -

(A) $\Delta\neq 0$.
(B) $\Delta\neq 0,\ \Delta_1=\Delta_2=\Delta_3=0$.
(C) $\Delta=0,\ \Delta_1=\Delta_2=\Delta_3=0$
(D) $\Delta=0,$ at least one of $\Delta_1,\ \Delta_2,\ \Delta_3\neq 0$.

21. Two cards are drawn successively with replacement form a pack of cards. The probability that only one of them is an Ace is -

(A) $\frac{144}{169}$. (B) $\frac{24}{169}$.

(C) $\frac{1}{169}$. (D) 0.

22. Given ω is a cube root of unity. Then ω is -

(A) $\frac{1+i}{\sqrt{2}}$. (B) $\frac{1-i}{\sqrt{2}}$.

(C) $\frac{-1\pm i\sqrt{3}}{2}$. (D) $\frac{-1\pm i\sqrt{3}}{\sqrt{2}}$.

23. The set of all 2 × 2 non-singular matrices with respect to matrix multiplication is -

(A) a non-abelian group. (B) a semi-group.
(C) an abelian group. (D) not a group.

24. What substitution will reduce the equation $x\frac{dy}{dx}+y=x^3y^6$ into a linear equation?

(A) $y^6=z$. (B) $y^5=z$.
(C) $y^{-5}=z$. (D) $y^{-6}=z$.

25. $\left(\vec{a}\times\vec{b}\right)^2$ is equal to -

(A) a^2b^2.
(B) $a^2b^2\cos^2\theta$.
(C) $a^2b^2\sin^2\theta$.
(D) $ab\sin^2\theta$.

26. The slope of the tangent to the curve $y(x-2)(x-3)-x+7=0$ at the point where it cuts the x-axis is -

(A) -20.
(B) $-\frac{1}{20}$.
(C) $\frac{1}{20}$.
(D) 20.

27. $z=x^y+y^x$. The value of $\frac{\partial z}{\partial x}$ when $x=y=1$ is -

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

28. The value of $(1+i)(1+i^2)(1+i^3)(1+i^4)$ is -

(A) -1.
(B) 0.
(C) 1.
(D) $1+i+i^2$.

29. If $\vec{a}$, $\vec{b}$, $\vec{c}$, $\vec{d}$ represent the four sides of quadrilateral in an order, then the quadrilateral reduces to a parallelogram, if -

(A) $\vec{a}+\vec{b}=0$.
(B) $\vec{a}+\vec{c}=0$.
(C) $\vec{a}+\vec{d}=0$.
(D) $\vec{b}+\vec{c}=0$.

30. The inverse of the permutation $\begin{pmatrix}1&2&3&4\\2&4&1&3\end{pmatrix}$ is -

(A) $\begin{pmatrix}1&2&3&4\\3&1&4&2\end{pmatrix}$.
(B) $\begin{pmatrix}2&4&1&3\\1&2&3&4\end{pmatrix}$.
(C) $\begin{pmatrix}1&2&3&4\\3&1&2&4\end{pmatrix}$.
(D) $\begin{pmatrix}2&4&1&3\\3&1&2&4\end{pmatrix}$.

31. A balloon which always remains spherical has a variable diameter $\frac{3}{2}(2x+3)$. The rate of change of its volume with respect to x is -

(A) $\frac{9\pi}{16}(2x+3)^2$.
(B) $\frac{9\pi}{8}(2x+3)^2$.
(C) $\frac{27\pi}{8}(2x+3)^2$.
(D) $\frac{27\pi}{8}(2x+3)^3$.

32. If 0.3 is the probability of a bolt to be defective and ten are selected at random for inspection, the probability that at least one out of ten is defective is -

(A) $(0.7)^{10}$.
(B) $1-(0.7)^{10}$.
(C) $1-(0.3)^{10}$.
(D) $(0.3)^{10}$.

33. The projection of $\vec{i}+\vec{j}+\vec{k}$ on $3\vec{j}+4\vec{k}$ is -

(A) $\frac{7}{5\sqrt{3}}$.
(B) $\frac{7}{\sqrt{3}}$.
(C) $\frac{7}{5}$.
(D) $\frac{7}{26}$.

34. The argument of $\left[1+\left[\frac{1+i}{1-i}\right]^4-\left[\frac{1-i}{1+i}\right]^4\right]$ is -

(A) $\frac{-\pi}{4}$.
(B) 0.
(C) $\frac{\pi}{2}$.
(D) π.

35. Given the p. d. f. of X is $f(x)=\begin{cases} Ax, & 5<x<12 \\ 5\ , & \text{elsewhere} \end{cases}$. Then $P(6<X<8)$ is -

(A) $\frac{56}{119}$.
(B) $\frac{28}{119}$.
(C) $\frac{14}{119}$.
(D) $\frac{7}{119}$.

36. The solution of $(2D^2 - 7D + 3)y = 0$ is -

(A) $y = Ae^{-7x} + Be^{3x}$.
(B) $y = Ae^{-7x/2} + Be^{3x/2}$.
(C) $y = Ae^{\frac{1}{2}x} + Be^{7x}$.
(D) $y = Ae^{\frac{1}{2}x} + Be^{3x}$.

37. The value of the integral $\int_0^{\frac{3}{2}a} \sqrt{4a^2 + y^2}\, dy$ is -

(A) $a\left[\frac{15}{16} + \log 2\right]$.
(B) $a^2\left[\frac{15}{16} - \log 2\right]$.
(C) $2a^2\left[\frac{15}{16} + \log 2\right]$.
(D) $a^2\left[\frac{5}{4} - \log 2\right]$.

38. Given $f(x) = |x|$. At $x = 0$

(A) $f(x)$ has derivative value.
(B) $f(x)$ does not have a derivative but attains a maximum.
(C) $f(x)$ does not have a derivative but attains a minimum.
(D) $f(x)$ does not have a derivative and therefore it can neither attain a minimum nor a maximum.

39. Two vertices of a triangle have position vectors $3\vec{i} + 4\vec{j} - \vec{k}$ and $2\vec{i} + 3\vec{j} + 4\vec{k}$. If the position vector of its centroid is $\vec{i} + 2\vec{j} + 3\vec{k}$, then the position vector of the third vertex is -

(A) $-2\vec{i} - \vec{j} + 6\vec{k}$.
(B) $-2\vec{i} - \vec{j} - 6\vec{k}$.
(C) $2\vec{i} - \vec{j} + 6\vec{k}$.
(D) $-2\vec{i} + \vec{j} + 6\vec{k}$.

40. Which of the following is in determinable form?

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

41. If $|z - 3i| + |z + 3i| = 0$, then the locus of z is the -

(A) real axis.
(B) imaginary axis.
(C) circle $x^2 + y^2 = 1$.
(D) circle $x^2 + y^2 = 9$.

42. If $\text{Re}\left(\frac{z-2}{z+i}\right)=0$, then the locus of z is a -

(A) circle not through origin.
(B) circle through origin.
(C) straight line not through origin.
(D) straight line through origin.

43. Solution of $\frac{dy}{dx}=\frac{y+\sqrt{x^2+y^2}}{x}$ can be obtained by solving -

(A) $\frac{dv}{\sqrt{1+v^2 p}}=\frac{dx}{x}$.
(B) $\frac{vdv}{1+v^2}=\frac{dx}{x}$.
(C) $\frac{dv}{1+v^2}=\frac{dx}{x}$.
(D) $\frac{dv}{v+\sqrt{1+v^2}}=\frac{dx}{x}$.

44. $\lim_{x\to 0}\frac{5\sin x-8\sin 2x+3\sin 3x}{x^2\sin x}=$

(A) 0.
(B) -2.
(C) ∞.
(D) -5.

45. If S and T are subgroups of a group G, then which one of the following statements is always true?

(A) Neither $S\cup T$ nor $S\cap T$ is a subgroup of G.
(B) $S\cup T$ is a subgroup G.
(C) $S\cap T$ is a subgroup of G.
(D) Both $S\cup T$ and $S\cap T$ are subgroups of G.

46. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors having magnitudes 1, 2 and 3 respectively. If the projection of $\vec{b}$ along $\vec{a}$ is equal to that of $\vec{c}$ along $\vec{a}$ and $\vec{b}$ and $\vec{c}$ are perpendicular to each other, then $\left|\vec{a}-\vec{b}+\vec{c}\right|=$

(A) $\sqrt{14}$.
(B) $2\sqrt{14}$.
(C) $\sqrt{7}$.
(D) $2\sqrt{7}$.

47. In a triangle ABC if $\angle C=90^\circ$, then $\tan^{-1}\left(\frac{a}{b+c}\right)+\tan^{-1}\left(\frac{b}{c+a}\right)=$

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

48. If $|z| = 1$ and $w = \frac{z-1}{z+1}$, $z \neq -1$, then the real part of w =

(A) 1. (B) −1.
(C) 0. (D) 2.

49. If $\frac{(e-7)x^2+3x-e}{x^3-x} = \frac{A}{x} + \frac{B}{x-1} + \frac{C}{x+1}$, then $(\log_e A) - 2B + C$ is equal to -

(A) 1. (B) $e-1$.
(C) e. (D) 0.

50. If α, β and γ are the roots of $x^3 - 3x^2 + 5x - 7 = 0$, then $1 + \frac{1}{\alpha\beta} + \frac{1}{\beta\gamma} + \frac{1}{\gamma\alpha}$ is equal to -

(A) $\frac{3}{7}$. (B) $\frac{5}{7}$.
(C) $\frac{10}{7}$ (D) $\frac{15}{7}$.

51. If $a \tan \theta = b$, then $a \cos 2\theta + b \sin 2\theta$ =

(A) a. (B) b.
(C) $\frac{2ab}{a^2+b^2}$. (D) $\frac{2ab}{a^2-b^2}$.

52. The ends of a rod of length 3 units move on two mutually perpendicular lines. Then the locus of the point on the rod which divides it in the ratio 1 : 2 is -

(A) $4x^2 + y^2 = 4$. (B) $x^2 + 4y^2 = 1$.
(C) $x^2 + 4y^2 = 4$. (D) $4x^2 + y^2 = 1$.

53. If $\vec{a} = \hat{i} + \hat{j} + \hat{k}$, $\vec{a} \cdot \vec{b} = 1$, $\vec{a} \times \vec{b} = \hat{j} - \hat{k}$, then $\vec{b}$ =

(A) $\vec{o}$. (B) $\hat{k}$.
(C) $\hat{j}$. (D) $\hat{i}$.

54. If e_1 and e_2 are the eccentricities of the hyperbolas $xy = c^2$ and $x^2 - y^2 = c^2$ respectively, then $e_1^2 + e_2^2$ =

(A) 1. (B) 4.
(C) 6. (D) 9.

55. $\tan\left[\cot^{-1}9+\operatorname{cosec}^{-1}\frac{\sqrt{41}}{4}\right]=$

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

56. If $z=\cos\theta+i\sin\theta$, then $\frac{1+z^{2n}}{1-z^{2n}}=$

(A) $i\cot n\theta$.
(B) $i\tan n\theta$.
(C) $2\cos n\theta$.
(D) $2i\sin n\theta$.

57. If z_1, z_2 and z_3 are complex numbers such that

$|z_1| = |z_2| = |z_3| = \left|\frac{1}{z_1}+\frac{1}{z_2}+\frac{1}{z_3}\right|=1$, then $|z_1+z_2+z_3|=$

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

58. Let $\vec{a}$, $\vec{b}$ and $\vec{c}$ be three vectors having magnitudes 1, 1 and 2 respectively. If $\vec{a}\times\left(\vec{a}\times\vec{c}\right)+\vec{b}=\vec{0}$, then the acute angle between the vectors $\vec{a}$ and $\vec{c}$ is -

(A) $\frac{\pi}{2}$.
(B) $\frac{\pi}{3}$.
(C) $\frac{\pi}{6}$.
(D) $\frac{2\pi}{3}$.

59. The characteristic roots of the transpose of $\begin{pmatrix}1 & 4\\ 2 & 3\end{pmatrix}$ are -

(A) $1, -5$.
(B) $-1, 5$.
(C) $-1, -5$.
(D) $1, 5$.

60. $\lim_{x\to\infty}\left(1+\frac{1}{2+3x}\right)^{4+5x}=$

(A) $e^{5/3}$.
(B) $e^{3/5}$.
(C) e^{2}.
(D) $e^{1/2}$.

61. If $\log_2(2^{x-1}+6)+\log_2(4^{x-1})=5$, then x is equal to -

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

62. The value of $\sin^4\left(\frac{\pi}{8}\right)+\sin^4\left(\frac{3\pi}{8}\right)+\sin^4\left(\frac{5\pi}{8}\right)+\sin^4\left(\frac{7\pi}{8}\right)$ is -

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

63. The number of solutions of the equation $\tan x+\sec x=2\cos x$, in $(0,\pi)$ is -

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

64. If $\vec{a}$, $\vec{b}$ and $\vec{c}$ are non-coplanar vectors, then $(\vec{a}+\vec{b}-\vec{c})\bullet(\vec{a}-\vec{b})\times(\vec{b}-\vec{c})=$

(A) $2[\vec{a}\ \vec{b}\ \vec{c}]$.
(B) $[\vec{a}\ \vec{b}\ \vec{c}]$.
(C) $[\vec{a}\ \vec{b}\ \vec{c}]^2$.
(D) $3[\vec{a}\ \vec{b}\ \vec{c}]$.

65. $\tan\left(2\tan^{-1}\frac{1}{5}-\frac{\pi}{4}\right)=$

(A) $\frac{17}{7}$.
(B) $\frac{7}{17}$.
(C) $-\frac{7}{17}$.
(D) $-\frac{17}{7}$.

66. If $(1+i)(1+3i)\ldots(1+\overline{2n-1}\,i)=x+iy$, then 1.5.13 ... $(2n^2-2n+1)=$

(A) x^2+y^2.
(B) $\frac{x^2+y^2}{2^n}$.
(C) $\frac{x^2+y^2}{2}$.
(D) $2^n(x^2+y^2)$.

67. If $z = x + iy$ and $|z+6| = |2z+3|$, then -

(A) $x^2 + y^2 = 36$.
(B) $x^2 + y^2 = 81$.
(C) $x^2 + y^2 = 27$.
(D) $x^2 + y^2 = 9$.

68. The condition for two circles $x^2 + y^2 + 2ax + c = 0$ and $x^2 + y^2 + 2by + c = 0$ to touch each other externally is -

(A) $\frac{1}{a} + \frac{1}{b} = \frac{1}{c}$.
(B) $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{c}$.
(C) $a + b = c$.
(D) $a^2 + b^2 = c$.

69. Which one of the following groups is non-abelian?

(A) $\{1, 2, 3, 4\}$ under multiplication modulo 5.
(B) $\{1, w, w^2\}$, where $w^3 = 1$, under multiplication.
(C) S_3, under composition of maps.
(D) $\mathbb{R} - \{0\}$, under multiplication.

70. If α, β and γ are the roots of $x^3 + ax^2 + b = 0$, then $\begin{vmatrix} \alpha & \beta & \gamma \\ \beta & \gamma & \alpha \\ \gamma & \alpha & \beta \end{vmatrix} =$

(A) a^2.
(B) a^3.
(C) a.
(D) 0.

71. In any triangle ABC, if $\frac{1}{a+c} + \frac{1}{b+c} = \frac{3}{a+b+c}$, then $\angle C$ is -

(A) 45°.
(B) 90°.
(C) 60°.
(D) 30°.

72. If $f(x) = x^2 - 1$ and $g(x) = 2x + 3$, then $(f \circ g \circ f)(1)$ is equal to -

(A) 8.
(B) 6.
(C) 4.
(D) 5.

73. The value of $\dfrac{1}{1+\log_b a}+\dfrac{1}{1+\log_a b}$ is -

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

74. In the group $\mathbb{Z}_7-\{0\}$ under multiplication modulo 7, $2\times(5^{-1}\times 4)=$

(A) 5.
(B) 4.
(C) 3.
(D) 1.

75. The number of roots of the equation $\sqrt{x}+\sqrt{x-\sqrt{1-x}}=1$ (where $\sqrt{x}$ is the positive square root of x) is -

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

76. The tangents from P (4, 5) to the circle $x^2+y^2-4x-2y-11=0$ meet it at A and B. If C is the centre of the circle, then the area of the quadrilateral $PACB$ is -

(A) 4 sq. units.
(B) 6 sq. units.
(C) 8 sq. units.
(D) 10 sq. units.

77. $\dfrac{1}{\tan 3\theta-\tan\theta}-\dfrac{1}{\cot 3\theta-\cot\theta}=$

(A) $\cot 4\theta$.
(B) $\tan 2\theta$.
(C) $\cot 2\theta$.
(D) $\tan 4\theta$.

78. If $\tan\theta+\sec\theta=p$, then $\theta=$

(A) $\tan^{-1}\left(\dfrac{p^2-1}{2p}\right)$.
(B) $\tan^{-1}\left(\dfrac{2p}{p^2-1}\right)$.
(C) $\sec^{-1}\left(\dfrac{p^2-1}{2p}\right)$.
(D) $\sec^{-1}\left(\dfrac{2p}{p^2-1}\right)$.

79. If ω is an imaginary cube root of unity, then $(a+b)(a\omega+b\omega^2)(a\omega^2+b\omega)=$

(A) a^3+b^3.
(B) a^3-b^3.
(C) $(a+b)^3$.
(D) $(a-b)^3$.

80. Q^+ denotes the set of all positive rational numbers. Define * on Q^+ by $a*b=\frac{ab}{2}$ for all a, b in Q^+. If $(Q^+, *)$ is a group, which of the following is/are true?

(1) It is an infinite abelian group.
(2) Inverse of 2 is 2.
(3) It is a finite abelian group.
(4) Order of 2 is infinite.

(A) (1) only.
(B) (1) and (2) only.
(C) (1), (2) and (4) only.
(D) (2), (3) and (4) only.

81. Which of the following is not a group?

(A) $(Z_n, +_n)$
(B) (Z, +)
(C) (Z, •)
(D) (R, +)

82. If $f'(x)=\sqrt{x}$ and $f(1)=2$, then $f(x)$ is -

(A) $-\frac{2}{3}(x\sqrt{x}+2)$.
(B) $\frac{3}{2}(x\sqrt{x}+2)$.
(C) $\frac{2}{3}(x\sqrt{x}+2)$.
(D) $-\frac{3}{2}(x\sqrt{x}+2)$.

83. The curve $y=ax^3+bx^2+cx+d$ has a point of inflexion at $x = 1$, then -

(A) $a+b=0$.
(B) $a+3b=0$.
(C) $3a+b=0$.
(D) $3a+b=1$.

84. Which of the following statements are true?

(1) If z is a complex number, then its reflection in the real axis is $\bar{z}$.
(2) The real part of $\frac{1-i}{1+i}$ is 2.
(3) $\text{Re}(z)\leq |z|$.
(4) Locus of $Z^2=1$ is $xy=0$.

(A) (1) and (2).
(B) (1), (2) and (3).
(C) (1) and (3).
(D) (1), (3) and (4).

85. The area of the parallelogram determined by the sides $\vec{i}+2\vec{j}+3\vec{k}$ and $-3\vec{i}-2\vec{j}+\vec{k}$ is -

(A) $6\sqrt{5}$.
(B) $3\sqrt{5}$.
(C) 6.
(D) $4\sqrt{5}$.

86. If the rank of the matrix $\begin{bmatrix} \lambda & -1 & 0 \\ 0 & \lambda & -1 \\ -1 & 0 & \lambda \end{bmatrix}$ is 2, then λ is -

(A) 1.
(B) 2.
(C) 3.
(D) any real number.

87. The curve $9y^2 = x^2(4-x^2)$ is symmetrical about -

(A) y-axis only.
(B) x-axis only.
(C) $y = x$.
(D) both axes.

88. In a Poisson distribution, if P (X = 2) = P(X = 3), then the value of its parameter λ is -

(A) 6.
(B) 2.
(C) 3.
(D) 0.

89. The value of c in Rolle's theorem for the function $f(x) = \cos\frac{x}{2}$ on $(\pi, 3\pi)$ is -

(A) 0.
(B) 2π.
(C) $\frac{\pi}{2}$.
(D) $\frac{3\pi}{2}$.

90. What is the surface area of a sphere when the volume is increased at the same rate as its radius?

(A) 1
(B) $\frac{1}{\sqrt{2\pi}}$.
(C) 4π.
(D) $\frac{4\pi}{3}$.

91. G is a group under a binary operation *. If $(a*b)^{-1} = a^{-1}*b^{-1}$, then -

(A) G is finite.
(B) G consists of a single element only.
(C) G is commutative.
(D) G is non-commutative.

92. The integrating factor of the differential equation $\frac{dy}{dx} - y\tan x = \cos x$ is -

(A) $\sec x$.
(B) $\cos x$.
(C) $e^{\tan x}$.
(D) $\cot x$.

93. The function $f(x) = e^x$ -

(A) has maximum at $x = 0$.
(B) has minimum at $x = 0$.
(C) is decreasing.
(D) is increasing.

94. The image of $4 - 3i$ under a rotation of 90° about the origin in the clockwise direction is -

(A) $4 + 3i$.
(B) $4 - 3i$.
(C) $3 - 4i$.
(D) $3 + 4i$.

95. The lines $\frac{x}{1} = \frac{y}{2} = \frac{z}{3}$ and $\frac{x-1}{-2} = \frac{y-2}{-4} = \frac{z-3}{-6}$ are -

(A) parallel.
(B) intersecting.
(C) skew.
(D) coincident.

96. If $\vec{a}$ and $\vec{b}$ are two unit vectors and θ is the angle between them, then $(\vec{a}+\vec{b})$ is a unit vector if -

(A) $\theta = \frac{\pi}{3}$.
(B) $\theta = \frac{\pi}{4}$.
(C) $\theta = \frac{\pi}{2}$.
(D) $\theta = \frac{2\pi}{3}$.

97. If A is a square matrix of order n, then $|adj\ A|$ is -

(A) $|A|^2$.
(B) $|A|^n$.
(C) $|A|^{n-1}$.
(D) $|A|$.

98. If $f(x)=\frac{A}{\pi}\cdot\frac{1}{16+x^2}$, $-\infty<x<\infty$ is a p.d.f of a continuous random variable X, then the value of A is -

(A) 16. (B) 8.
(C) 4. (D) 1.

99. If ω is a cube root of unity, then the value of $(1-\omega+\omega^2)^4+(1+\omega-\omega^2)^4$ is -

(A) 0. (B) 32.
(C) -16. (D) -32.

100. The sum of the distances of any point on the ellipse $4x^2+9y^2=36$ from $(\sqrt{5},0)$ and $(-\sqrt{5},0)$ is -

(A) 4. (B) 8.
(C) 6. (D) 18.

101. The value of $i+i^{22}+i^{23}+i^{24}+i^{25}$ is -

(A) i. (B) $-i$.
(C) 1. (D) -1.

102. The value of $\left(\frac{-1+i\sqrt{3}}{2}\right)^{100}+\left(\frac{-1-i\sqrt{3}}{2}\right)^{100}$ is -

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

103. The number of roots of $(\cos\theta+i\sin\theta)^{\frac{x}{y}}$ is -

(A) x (B) y
(C) $x+y$ (D) xy

104. The differential equation $\frac{dy}{dx}+y\sec^2 x=0$ can be solved by -

(1) variable separable.
(2) homogeneous.
(3) linear.
(4) 2nd order.

(A) (1) and (2). (B) (2) and (3).
(C) (1) and (3). (D) (1), (2) and (3).

105. If every element of a group G is its own inverse, then the element $a \neq e$ in G is of order -

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

106. In which region the curve $y^2(a+x) = x^2(3a-x)$ does not lie?

(A) $x > 0$.
(B) $0 < x < 3a$.
(C) $x < -a$ and $x > 3a$.
(D) $-a < x < 3a$.

107. For what value of x is the rate of increase of $x^3 - 2x^2 + 3x + 8$ is twice the rate of increase of x?

(A) $\left(-\frac{1}{3}, -3\right)$.
(B) $\left(\frac{1}{3}, 3\right)$.
(C) $\left(-\frac{1}{3}, 3\right)$.
(D) $\left(\frac{1}{3}, 1\right)$.

108. The directrix of the hyperbola $x^2 - 4(y-3)^2 = 16$ is -

(A) $y = \pm\frac{8}{\sqrt{5}}$.
(B) $x = \pm\frac{8}{\sqrt{5}}$.
(C) $y = \pm\frac{\sqrt{5}}{8}$.
(D) $x = \pm\frac{\sqrt{5}}{8}$.

109. If $|\vec{a}+\vec{b}| = |\vec{a}-\vec{b}|$, then -

(A) $\vec{a}$ is parallel to $\vec{b}$.
(B) $\vec{a}$ is perpendicular to $\vec{b}$.
(C) $|\vec{a}| = |\vec{b}|$.
(D) $\vec{a}$ and $\vec{b}$ are unit vectors.

110. The work done by the force $\vec{F} = \vec{i} + \vec{j} + \vec{k}$ acting on a particle, if the particle is displaced from A (3, 3, 3) to the point B (4, 4, 4) is -

(A) 2 units.
(B) 3 units.
(C) 4 units.
(D) 7 units.

111. In a system of 3 linear homogeneous equations with three unknowns, if $\Delta = 0$ and $\Delta_x = 0$, $\Delta_y \neq 0$ and $\Delta_z = 0$, then the system has -

(A) unique solution.
(B) two solutions.
(C) infinitely many solutions.
(D) no solution.

112. If $a = 3 + i$ and $z = 2 - 3i$, then the points on the Argand diagram representing az, $3az$ and $-az$ are -

(A) the vertices of a right angled triangle.
(B) the vertices of an equilateral triangle.
(C) the vertices of an isosceles triangle.
(D) collinear.

113. $\lim_{x \to \infty} \frac{x^2}{e^x}$ is -

(A) 2.
(B) 0.
(C) 4.
(D) 1.

114. The particular integral of $(3D^2 + D - 14)y = 13e^{2x}$ is -

(A) $26xe^{2x}$.
(B) $13xe^{2x}$.
(C) xe^{2x}.
(D) $\frac{x^2}{2}e^{2x}$.

115. If $\vec{a}$ and $\vec{b}$ are collinear and are in the opposite direction, then θ is -

(A) 0.
(B) $\frac{\pi}{2}$.
(C) π.
(D) $\frac{\pi}{4}$.

116. The value of $\int_{-\pi/2}^{\pi/2} \left(\frac{\sin x}{2 + \cos x} \right) dx$ is -

(A) 0.
(B) 2.
(C) log 2.
(D) log 4.

117. Which of the following is not an abelian group?

(A) (Z, +).
(B) (Q – {0}, •)
(C) $(G, *)$ where $G = \{e, a, b, c\}$ and * a binary operation defined on it.
(D) The set of all 2 × 2 non-singular matrices under matrix multiplication.

118. The eccentricity of the ellipse $4x^2 + y^2 - 8x - 6y = 3$ is -

(A) $\frac{1}{\sqrt{2}}$.
(B) $\frac{3}{4}$.
(C) $\frac{\sqrt{3}}{4}$.
(D) $\frac{\sqrt{3}}{2}$.

119. The value of $\int_0^1 x(1-x)^4 dx$ is -

(A) $\frac{1}{12}$.
(B) $\frac{1}{30}$.
(C) $\frac{1}{24}$.
(D) $\frac{1}{20}$.

120. The rank of the lower triangular matrix $\begin{bmatrix} -1 & & & & \\ & 2 & & & \\ & & 0 & & \\ & & & 4 & \\ & & & & 0 \end{bmatrix}$ is -

(A) 0.
(B) 2.
(C) 3.
(D) 5.

121. If $\frac{1-i}{1+i}$ is a root of the equation $ax^2 + bx + 1 = 0$, then (a, b) is -

(A) (1, 1).
(B) (1, – 1).
(C) (0, 1)
(D) (1, 0).

122. Which of the following is false?

(A) Every group of order 4 is abelian.
(B) The identity element is the only element of order 1 in a group.
(C) (Z, +) is an abelian group.
(D) $(Z_n, \bullet_n)$ is non-abelian group.

123. A monoid becomes a group if it also satisfies the -

(A) closure axiom.
(B) associative axiom
(C) identity axiom.
(D) inverse axiom.

124. If the projection of $\vec{a}$ on $\vec{b}$ and the projection of $\vec{b}$ on $\vec{a}$ are equal, then the angle between $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ is -

(A) $\frac{\pi}{2}$.
(B) $\frac{\pi}{3}$.
(C) $\frac{\pi}{4}$.
(D) $\frac{2\pi}{3}$.

125. Which of the following is correct?

(A) An element of a group can have more than one inverse.
(B) If every element of a group is its own inverse, then the group is abelian.
(C) The set of all 2 × 2 real matrices forms a group under matrix multiplication.
(D) $(a*b)^{-1} = a^{-1}*b^{-1}$ for all $a, b \in G$.

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