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COMBINED COMPETITIVE (PRELIMINARY) EXAMINATION, 2012

Serial No.

MATHEMATICS

Code No. 13

A

Time Allowed : Two Hours

Maximum Marks : 300

INSTRUCTIONS

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7. All items carry equal marks. Attempt ALL items. Your total marks will depend only on the number of correct responses marked by you in the Response Sheet.
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ROUGH WORK

1. In a group of 1000 people, there are 750 people who can speak Hindi and 400 who can speak English. Then number of people who can speak Hindi only is :

(A) 300 (B) 400

(C) 600 (D) 150

2. The composite mapping $f \circ g$ of the mappings $f : \mathbb{R} \to \mathbb{R}$, $f(x) = \sin x$ and $g : \mathbb{R} \to \mathbb{R}$, $g(x) = x^2$ is :

(A) $\sin x + x^2$ (B) $(\sin x)^2$

(C) $\sin x^2$ (D) $\dfrac{\sin x}{x^2}$

3. Let $\mathbb{R}$ be the set of real numbers. If $f : \mathbb{R} \to \mathbb{R}$ is defined by $f(x) = e^x$, then f is :

(A) surjective but not injective (B) injective but not surjective

(C) bijective (D) neither surjective nor injective

4. n/m means that n is a factor of m, then the relation 'l' is :

(A) reflexive and symmetric

(B) transitive and symmetric

(C) reflexive, transitive and symmetric

(D) reflexive, transitive and not symmetric

5. If A and B are defined as :

$$A = \{(x, y) : y = e^x, x \in \mathbb{R}\}$$

$$B = \{(x, y) : y = x, x \in \mathbb{R}\}$$

then :

(A) $B \subset A$ (B) $A \subset B$

(C) $A \cap B = \phi$ (D) $A \cup B = A$

6. The sets A and B have 3 and 6 elements respectively. What can be the minimum number of elements in $A \cup B$?

(A) 18 (B) 9

(C) 6 (D) 3

7. If A, B and C are non empty subsets of a set then $(A - B) \cup (B - A)$ equals :

(A) $(A \cap B) \cup (A \cup B)$ (B) $(A \cup B) - (A \cap B)$

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

8. The smallest positive integer n for which $(1 + i)^{2n} = (1 - i)^{2n}$ is :

   (A) 4 (B) 8

   (C) 2 (D) 12

9. If $iz^3 + z^2 - z + i = 0$, where z is a complex number, then $|z| =$

   (A) 1 (B) i

   (C) –1 (D) –i

10. The equation $| z + 1 - i | = | z + i - 1 |$ represents :

    (A) a straight line (B) a circle

    (C) a parabola (D) a hyperbola

11. If $\frac{1}{x} + x = 2\cos\theta$, then $\frac{1}{x^n} + x^n$ is equal to :

    (A) $2 \cos n\theta$ (B) $2 \sin n\theta$

    (C) $\cos n\theta$ (D) $\sin n\theta$

12. If $x^2 = e$ for all elements x of a group G, then :

    (A) G must be cyclic (B) G must be non-abelian

    (C) G must be abelian (D) G must be a finite group

13. Which of the following is not a group ?

    (A) $(\mathbb{Z}_n, +_n)$ (B) $(\mathbb{Z}, +)$

    (C) $(\mathbb{Z}, \cdot)$ (D) $(\mathbb{R}, +)$

14. The binary operation '$\circ$' on $\mathbb{R}$ defined by $x \quad y = x^y + y^x$ is :

    (A) Commutative and associative (B) Commutative but not associative

    (C) Associative but not commutative (D) Neither commutative nor associative

15. The characteristic of the ring $2\mathbb{Z}$ is :

    (A) 2 (B) 3

    (C) 1 (D) 0

16. If A and B are matrices such that AB = A, BA = B then B^2 is equal to :

    (A) B (B) A

    (C) I (D) O

17. If the product matrix AB is zero, then :

(A) A = 0 or B = 0

(B) It is not necessary that either A = 0 or B = 0

(C) A = 0 and B = 0

(D) All the above statements are false

18. If A and B are two non singular matrices of order n then :

(A) AB is non-singular

(B) AB is singular

(C) $(AB)^{-1} = A^{-1} B^{-1}$

(D) $(AB)^{-1}$ does not exist

19. If A and B are 2 × 2 matrices then det (A + B) = 0 implies :

(A) det A = 0 and det B = 0

(B) det A + det B = 0

(C) det A = 0 or det B = 0

(D) None of these

20. If $X = \begin{bmatrix} 3 & -4 \\ 1 & -1 \end{bmatrix}$, then the value of X^n is :

(A) $\begin{bmatrix} 3^n & (-4)^n \\ 1^n & (-1)^n \end{bmatrix}$

(B) $\begin{bmatrix} 3n & -4n \\ n & -n \end{bmatrix}$

(C) $\begin{bmatrix} 2+n & 5-n \\ n & -n \end{bmatrix}$

(D) None of these

21. The system of equations :

$x + y + z = 2$

$2x + y - z = 3$

$3x + 2y + kz = 4$

has a unique solution, if :

(A) $k \neq 0$

(B) $-1 < k < 1$

(C) $-2 < k < 2$

(D) $k = 0$

22. The system :

$x + 2y + 3z = 1$

$x - y + 4z = 0$

$2x + y + 7z = 1$

have :

(A) only two solutions

(B) only one solution

(C) no solution

(D) infinitely many solutions

23. If AB = 0 for the matrices :

$$A = \begin{bmatrix} \cos^2\theta & \cos\theta\sin\theta \\ \cos\theta\sin\theta & \sin^2\theta \end{bmatrix}, \quad B = \begin{bmatrix} \cos^2\phi & \cos\phi\sin\phi \\ \cos\phi\sin\phi & \sin^2\phi \end{bmatrix}$$

then $\theta - \phi$ is :

(A) an odd multiple of $\frac{\pi}{2}$ (B) an odd multiple of π

(C) an even multiple of (D) 0

24. The rank of the matrix is :

(A) 3 (B) 2

(C) 1 (D) –2

25. The value of the determinant of n^{th} order $\begin{vmatrix} x & 1 & 1 \text{..........} \\ 1 & x & 1 \text{..........} \\ 1 & 1 & x \text{..........} \\ \text{......................} \end{vmatrix}$ is :

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

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

26. If 1, w, w^2 are the cube roots of unity, then $D = \begin{vmatrix} 1 & w^n & w^{2n} \\ w^{2n} & 1 & w^n \\ w^n & w^{2n} & 1 \end{vmatrix}$ has the value :

(A) 0 (B) w

(C) w^2 (D) 1

27. If $\Delta = \begin{vmatrix} 1 & 3\cos\theta & 1 \\ \sin\theta & 1 & 3\cos\theta \\ 1 & \sin\theta & 1 \end{vmatrix}$ then maximum value of Δ is :

(A) 1 (B) 9

(C) 16 (D) None of these

28. If d is the determinant of a square matrix A of order n, then the determinant of its adjoint is :

(A) d^n (B) d^{n-1}

(C) d^{n+1} (D) d

29. If A is a square matrix of order 3 and A = 5B then | A | =

(A) 5 | B | (B) 25 | B |

(C) 125 | B | (D) None of these

30. If $f(x) = x^2 - 4x + 1$ and $A = \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix}$ then f(A) is :

(A) null matrix (B) identity matrix

(C) $\begin{bmatrix} 4 & 6 \\ -2 & 4 \end{bmatrix}$ (D) none of these

31. The domain of the function $f(x) = \sqrt{x-1} + \sqrt{5-x}$ is :

(A) $[1, \infty)$ (B) $(-\infty, 5)$

(C) (1, 5) (D) [1, 5]

$\frac{7n(n+1)}{2}$ $\lim_{x\to 0}\frac{(1+x)^n - 1}{x}$

32. If $f : \mathbb{R} \to \mathbb{R}$ satisfies the relation f(x + y) = f(x) + f(y), for all x, y ∈ $\mathbb{R}$ and f(1) = 7, then $\sum_{r=1}^{n} f(r)$ is :

(A) $\frac{7n}{2}$ (B) $\frac{7(n+1)}{2}$

(C) 7n(n + 1) (D)

33. The cardinality of the set A = {ϕ} is :

(A) 0 (B) 1

(C) –1 (D) 2

34. is :

(A) (n – 1) ! (B) n !

(C) n (D) –n

35. If $f(x)=\begin{cases} x\ , & \text{when } x \text{ is rational} \\ 1-x, & \text{when } x \text{ is irrational} \end{cases}$

then :

(A) f is continuous for all reals x

(B) f is discontinuous for all reals x

(C) f is continuous only at $x=\frac{1}{2}$

(D) f is discontinuous only at $x=\frac{1}{2}$

36. Let $f = \mathbb{R} \to \mathbb{R}$ be a function defined by $f(x) = \max\{x, x^3\}$. The set of all points where f(x) is not differentiable is :

(A) {–1, 1} (B) {–1, 0}

(C) {0, 1} (D) {–1, 0, 1}

37. If $y = \sin(m \sin^{-1} x)$, then $(1 - x^2) y'' - xy'$ is equal to :

(A) m^2y (B) my

(C) $-m^2y$ (D) None of these

38. If y = cos x cos 2x cos 4x cos 8x, then $f'\left(\frac{\pi}{4}\right)$ is :

(A) –1 (B) 2

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

39. The greatest value of $f(x) = x^5 - 5x^4 + 5x^3 + 12$ on [0, 1] is :

(A) 13 (B) 1

(C) 0 (D) –13

40. The set of values of x for which log (1 + x) < x, is :

(A) x < 0 (B) x > 0

(C) 0 < x < 1 (D) x < 1

41. If $p(x) = a_0 + a_1x^2 + a_2x^4 + a_3x^6 + ... + a_nx^{2n}$ be a polynomial in $x \in \mathbb{R}$ with $0 < a_1 < a_2 < .... < a_n$, then p(x) has :

(A) no point of minimum (B) only one point of minimum

(C) only two points of minimum (D) none of these

42. The function $f : \mathbb{R} \to \mathbb{R}$ defined by $f(x) = (x + 2)\, e^{-x}$ is :

(A) decreasing for all x

(B) decreasing in $(-\infty, -1)$ and increasing in $(-1, \infty)$

(C) increasing for all x

(D) decreasing in $(-1, \infty)$ and increasing in $(-\infty, -1)$

43. The lines $\frac{x-2}{1} = \frac{y-3}{1} = \frac{z-4}{-k}$ and $\frac{x-1}{k} = \frac{y-4}{2} = \frac{z-5}{1}$ are coplanar if :

(A) $k = 0$ or -1 (B) $k = 1$ or -1

(C) $k = 0$ or -3 (D) $k = 3$ or -3

44. The equation of the normal to the curve $x^2 = 4y$ passing through the point (1, 2) is :

(A) $x + y + 3 = 0$ (B) $x - y - 3 = 0$

(C) $2x + y = 4$ (D) $2x - y = 1$

45. Area of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is :

(A) πab (B) $\frac{\pi ab}{2}$

(C) $\frac{\pi ab}{4}$ (D) $\frac{\pi ab}{3}$

46. If f(x) is an odd function, then $\int_{a}^{x} f(t)\, dt$ is :

(A) an odd function (B) even function

(C) neither even nor odd (D) none of these

47. Find the area of the segment of the parabola $y = x^2 - 5x + 15$ cut off by a straight line $y = 3x + 3$:

(A) $\frac{32}{3}$ (B) 0

(C) 1 (D) None

48. If $f(x)=\begin{cases} e^{\cos x}\cdot\sin x, & |x|\le 2 \\ 2 &, \text{ otherwise}\end{cases}$ then $\int_{-2}^{3} f(x)\,dx$ is equal to :

(A) 0 (B) 1

(C) 2 (D) 3

49. Let g(x) = $\int_0^x f(t)\,dt$, where $f(t)=\begin{cases}\left[\frac{1}{2},1\right], & \forall\, t\in[0,1] \\ \left[0,\frac{1}{2}\right], & \forall\, t\in(1,2]\end{cases}$

then :

(A) $g(2)\in\left[\frac{-3}{2},\frac{1}{2}\right)$ (B) $g(2)\in\left[\frac{1}{2},\frac{3}{2}\right]$

(C) $g(2)\in\left[\frac{3}{2},\frac{5}{2}\right)$ (D) $g(2)\in(2,4)$

50. Let .

Then real roots of the equation $x^2 - f'(x) = 0$ are :

(A) ±1 (B) $\pm\frac{1}{\sqrt{2}}$

(C) $\pm\frac{1}{2}$ (D) 0 and 1

51. Let T > 0 be a fixed number. Suppose f is a continuous function, such that for all x ∈ ℝ,

f(x + T) = f(x). If $I=\int_0^T f(x)\,dx$ then the value of $\int_3^{3+3T} f(2x)\,dx$ is :

(A) $\frac{3}{2}I$ (B) 2I

(C) 3I (D) 6I

52. The area of region bounded by y = | x – 1 | and y = 1 is :

(A) 2 (B) 1

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

53. The value of $\int_{\pi/6}^{\pi/3} \frac{\sqrt{\sin x}}{\sqrt{\sin x}+\sqrt{\cos x}}\,dx$ is equal to :

(A) $\frac{\pi}{4}$ (B)

(C) (D)

54. If $I_n = \int_0^{\pi/4} \tan^n x \, dx$, then $I_n + I_{n-2} =$

(A) 1 (B) $n-1$

(C) $\frac{1}{n-1}$ (D) $\frac{1}{n(n-1)}$

55. $\int_0^{2\pi} \frac{dx}{1+e^{\sin x}}\,dx$ is equal to :

(A) π (B) 2π

(C) $\frac{\pi}{2}$ (D) $-\pi$

56. $\int_{-1}^{1} |x|\,dx$ is :

(A) 1 (B) 0

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

57. $\int_0^1 x\,e^{2x}\,dx$ is :

(A) $\frac{1}{4}(1+e^2)$ (B) $\frac{1}{4}(1-e^2)$

(C) 0 (D) $\frac{1}{4}(1+e^{-2})$

58. $\int_{0}^{\pi/2} \cos^5\left(\frac{x}{2}\right)\cdot \sin x\, dx$ is equal to :

(A) $\frac{2}{7}\left(1-\frac{1}{8\sqrt{2}}\right)$ (B) $-\frac{4}{7}\left(1-\frac{1}{8\sqrt{2}}\right)$

(C) $\frac{4}{7}\left(1-\frac{1}{8\sqrt{2}}\right)$ (D) $-\frac{2}{7}\left(1-\frac{1}{8\sqrt{2}}\right)$

59. $\int_{0}^{\pi/2} \sin 2x \log \cot x\, dx$ is :

(A) $\frac{1}{2}$ (B) 1

(C) 0 (D) $-\frac{1}{2}$

60. The area bounded by the curves $y^2 = 8x$ and $x^2 = 8y$ is :

(A) $\frac{32}{7}$ (B) $\frac{24}{7}$

(C) $\frac{72}{7}$ (D) $\frac{64}{3}$

61. Let a_n be the n^{th} term of the G.P. of positive numbers. Let $\sum_{n=1}^{100} a_{2n} = \alpha$ and $\sum_{n=1}^{100} a_{2n-1} = \beta$ such that $\alpha \neq \beta$, then the common ratio is :

(A) $\frac{\alpha}{\beta}$ (B)

(C) (D) $\sqrt{\frac{\beta}{\alpha}}$

62. The sum of the first n terms of the series $\frac{1}{2}+\frac{3}{4}+\frac{7}{8}+\frac{15}{16}+..........$ is :

(A) $2^n - 1$ (B) $1 - 2^{-n}$

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

63. If $a^{\frac{1}{x}} = b^{\frac{1}{y}} = c^{\frac{1}{z}}$ and a, b, c are in G.P., then x, y, z are in :

(A) A.P. (B) G.P.

(C) H.P. (D) None of these

64. The next term of the sequence 1, 5, 14, 30, 55, ... is :

(A) 91 (B) 85

(C) 90 (D) 95

65. The value of :

$$1 + (1 + 2) + (1 + 2 + 3) + \ldots\ldots + (1 + 2 + 3 + \ldots\ldots n)$$

is :

(A) $n(n + 1)$ (B) $\frac{n(n+1)(n+2)}{6}$

(C) 1 (D) $\frac{n(n+1)}{6}$

66. If $S_n = \sum_{r=1}^{n} \frac{2r+1}{r^4 + 2r^3 + r^2}$ then S_{20} is equal to :

(A) $\frac{220}{221}$ (B) $\frac{420}{441}$

(C) $\frac{439}{221}$ (D) $\frac{440}{441}$

67. The infinite series $\sum_{n=1}^{\infty} \frac{x^n}{\sqrt{n}}$:

(A) Converges for all $x \in \mathbb{R}$ (B) Converges for all $x \in [-1, 1)$

(C) Diverges for all $x \in [-1, 1)$ (D) Converges for all $x \in [-1, 1]$

68. The series $1 + x + x^2 + x^3 + \ldots\ldots$ is the expansion of the function :

(A) $\frac{1}{1+x}$ (B) $\frac{1}{1-x}$

(C) $\frac{1}{x-1}$ (D) $\frac{1}{-1-x}$

69. The series $\sum_{n=2}^{\infty} \frac{1}{n \log n}$ is :

(A) convergent (B) divergent

(C) absolutely convergent (D) oscillatory

70. The series $1 - \frac{1}{2\sqrt{2}} + \frac{1}{3\sqrt{3}} - \frac{1}{4\sqrt{4}} + \ldots\ldots\ldots\ldots$ is :

(A) convergent (B) divergent

(C) absolutely convergent (D) oscillatory

71. The degree of the differential equation $x = 1 + \left(\frac{dy}{dx}\right) + \frac{1}{2!}\left(\frac{dy}{dx}\right)^2 + \frac{1}{3!}\left(\frac{dy}{dx}\right)^3$ is :

(A) Three (B) One

(C) Not defined (D) None of these

72. The differential equation representing the family of curves $y^2 = 2c\,(x + \sqrt{c})$, where c is a positive parameter is of :

(A) order 1, degree 3 (B) order 2, degree 3

(C) order 3, degree 1 (D) order 1, degree 1

73. Solution of the equation $\frac{dy}{dx} = e^{x-y}\,(e^x - e^y)$ is :

(A) $e^y = e^x - 1 + c\, e^{-e^x}$ (B) $e^y = e^x - 1 + c\, e^{e^x}$

(C) $e^x = e^y - 1 + c\, e^{-e^y}$ (D) $e^x = e^y - 1 + c\, e^{e^y}$

74. The solution of $\frac{dy}{dx} = \frac{ax + g}{by + f}$ represents a circle when :

(A) a = b (B) a = –b

(C) a = –2b (D) a = 2b

75. If 2f(x) = f′(x) and f(0) = 3, then f(2) equals :

(A) $4\, e^3$ (B) $3\, e^4$

(C) $2\, e^3$ (D) $3\, e^2$

76. Integrating factor of the differential equation $\cos x \dfrac{dy}{dx} + y \sin x = 1$ is :

(A) sin x

(B) $\sec^2 x$

(C) tan x

(D) cos x

77. The differential equation $(3a^2x^2 + by \cos x)\, dx + (2 \sin x - 4ay^3)\, dy = 0$ is exact for :

(A) any value of a and $b \neq 2$

(B) any value of a and $b = 2$

(C) any value of b and $a = 2$

(D) any values of a and b

78. General solution of $\dfrac{\partial^2 u}{\partial x^2} + \dfrac{\partial^2 u}{\partial y^2} = 0$ is of the form :

(A) $u = f(x + iy) + g(x - iy)$

(B) $u = f(x - iy) + g(x + iy)$

(C) $u = f(x + iy) - g(x - iy)$

(D) $u = f(x - iy) - g(x + iy)$

79. Orthogonal trajectories of $xy = c^2$ are :

(A) $x^2 = y +$ constant

(B) $x^2 + y^2 =$ constant

(C) $x^2 - y^2 =$ constant

(D) $x - y =$ constant

80. If $y = A \sin x + B \cos x$, then the value of $\dfrac{d^2y}{dx^2} + y$ is :

(A) sin x + cos x

(B) 2

(C) 1

(D) 0

81. If $x = a \sec \theta$, $y = b \tan \theta$ then $\dfrac{dy}{dx}$ is :

(A) $\dfrac{b}{a} \operatorname{cosec} \theta$

(B) $\dfrac{a}{b} \tan \theta$

(C) $\dfrac{a}{b}$

(D) $\dfrac{a}{b} \operatorname{cosec} \theta$

82. The differential equation of all lines in a plane which are at a constant distance p from origin is :

(A) $(p^2 - x^2)\left(\frac{dy}{dx}\right)^2 - 2xy\frac{dy}{dx} + p^2 - y^2 = 0$

(B) $(p^2 - x^2)\frac{dy}{dx} + y = 0$

(C) $\left(\frac{dy}{dx}\right)^2 - 2xy\frac{dy}{dx} + y^2 = 0$

(D) None

83. The set G = {1, –1, i, –i} is a group with respect to :

(A) addition (B) subtraction

(C) division (D) multiplication

84. Which one of the following is true ?

(A) Every field is an integral domain (B) Every integral domain is a field

(C) $\mathbb{Z}$ is a subfield of Q (D) All of these

85. The symmetric group S_3 has :

(A) 4 elements (B) 6 elements

(C) 3 elements (D) 8 elements

86. The order and degree of the differential equation $\frac{dy}{dx} + \int y\,dx = x$ is :

(A) order 1, degree 1 (B) order 2, degree 1

(C) order 2, degree 2 (D) order 1, degree 2

87. The differential equation $(x^3 + 3y^2x)dx + (y^3 + 3x^2y)dy = 0$ is :

(A) not exact (B) not homogeneous

(C) both exact and homogeneous (D) neither exact nor homogeneous

88. The integrating factor of the equation y log y dx + (x – log y)dy = 0 is :

(A) $\frac{1}{y^2}$ (B) $\frac{1}{x^2}$

(C) $\frac{1}{xy}$ (D) $\frac{1}{y}$

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89. The equation of the curve of degree 2 which passes through (0, 3), (1, 6), (2, 11) and (3, 18) is :

(A) $x^2 + 5x + 3$ (B) $x^2 + 2x + 3$

(C) $x^2 + x + 3$ (D) $x^2 + 3x + 3$

90. The points $\left(0, \frac{8}{3}\right)$, (1, 3) and (82, 30) are vertices of :

(A) an obtuse angled triangle (B) an acute angled triangle

(C) a right angled triangle (D) none of these

91. The gradient of one of the lines $x^2 + hxy + 2y^2 = 0$ is twice that of the other, then h =

(A) ± 3 (B) $\pm \frac{3}{2}$

(C) ± 2 (D) ± 1

92. The maximum value of $z = 0.5y - 0.1x$ subject to the constraints $2x + 5y \leq 80$, $x + y \leq 20$, $x, y \geq 0$ is :

(A) 2 (B) 6

(C) 8 (D) 10

93. The angle between the lines represented by the equation $\lambda x^2 + (1 - \lambda)xy - \lambda y^2 = 0$ is :

(A) 30º (B) 60º

(C) 90º (D) 45º

94. The circles $x^2 + y^2 - 10x + 16 = 0$ and $x^2 + y^2 = r^2$ intersect each other in two distinct points if :

(A) $r < 2$ (B) $r > 8$

(C) $2 < r < 8$ (D) $2 \leq r \leq 8$

95. If the equation $kx^2 + 2y^2 - 5xy + 5x - 7y + 3 = 0$ represents two straight lines, then the value of k will be :

(A) 0 (B) 2

(C) 4 (D) –6

96. The equations of tangents to the circle $x^2 + y^2 = 25$ which are inclined at angle of 30º to the X-axis are :

(A) $y = x\sqrt{3} \pm 5$ (B) $\sqrt{3}y = x \pm 10$

(C) $\pm\sqrt{3}y = x + 10$ (D) $y = \sqrt{3}x \pm 10$

97. Two circles $x^2 + y^2 - 2x - 4y = 0$ and $x^2 + y^2 - 8y - 4 = 0$:

(A) touch externally (B) touch internally

(C) intersect (D) do not touch

98. The curve described parametrically by $x = t^2 + t + 1$, $y = t^2 - t + 1$ represents :

(A) a pair of straight lines (B) an ellipse

(C) a parabola (D) a hyperbola

99. If the normals at the point $(at^2, 2at)$ meets the parabola again at $(at_1^2, 2at_1)$ then :

(A) $t_1 + t = -\frac{2}{t}$ (B) $t_1 = t + \frac{2}{t}$

(C) $t_1 = -\frac{2}{t}$ (D) $t - t_1 = 2$

100. Cosine of the angle which the vector $\bar{a} = 3\bar{i} - 6\bar{j} + 2\bar{k}$ makes with X axis is :

(A) $-\frac{6}{7}$ (B) $\frac{3}{7}$

(C) $\frac{2}{7}$ (D) $\frac{1}{7}$

101. The direction ratios of the line joining the points (2, 2, 1) and (3, –1, 3) are :

(A) 2, –1, 4 (B) 1, 1, 0

(C) 0, 1, 0 (D) 1, –3, 2

102. The perpendicular distance of the point (2, –3, 1) from the plane $x - 2y - 3z - 10 = 0$ is :

(A) $\frac{4}{\sqrt{13}}$ (B) $\frac{6}{\sqrt{2}}$

(C) $\frac{5}{\sqrt{14}}$ (D) 2

103. The equation of the plane passing through the point (2, 3, 4) and parallel to the plane $x + 2y + 4z = 5$ is :

(A) $x + 2y + 4z = 10$ (B) $x + 2y + 4z = 3$

(C) $x + y + 2z = 2$ (D) $x + 2y + 4z = 24$

104. The equation of the cylinder whose generators are parallel to z-axis and intersects the curve $ax^2 + by^2 = 2z$, $lx + my + nz = p$ is :

(A) $2lx + 2my + n(ax^2 + by^2) = 0$ (B) $2lx + 2my + n(ax^2 + by^2) = 2p$

(C) $lx + my + nz + ax^2 + by^2 = 0$ (D) None of these

105. If two forces acting at right angles have their resultant $\sqrt{10}$ kg. wt. and when they act at an angle of 60°, the resultant is $\sqrt{13}$ kg. wt., then the forces are :

(A) 3 kg. wt., 1 kg. wt. (B) 2 kg. wt., 2 kg. wt.

(C) 4 kg. wt., 1 kg. wt. (D) None of these

106. Three like parallel forces P, Q, R act at the corner points of a triangle ABC. Their resultant passes through the circumcenter if :

(A) $\frac{P}{2} = \frac{Q}{3} = \frac{R}{4}$ (B) $P = Q = R$

(C) $P + Q + R = 0$ (D) $P = \frac{1}{2}(Q + R)$

107. A force $3\bar{i} + 4\bar{j} + \bar{k}$ displaces a particle with displacement $p\bar{i} + 3\bar{j} + \bar{k}$. If the work done is 10 units, the value of p is :

(A) –1 (B) 1

(C) 2 (D) 3

108. The maximum horizontal range of a projectile when the velocity of projection is 28 m/sec is :

(A) 40 m (B) 80 m

(C) 100 m (D) 60 m

109. If T is the time of flight, R the horizontal range and α the angle of projection of a particle, then $\tan\alpha =$

(A) $\frac{gT}{2R}$ (B) $\frac{gT^2}{R}$

(C) $\frac{gT^2}{2R}$ (D) $\frac{T^2}{2Rg}$

110. If the resultant of two forces of magnitude P and 2P is perpendicular to P, then the angle between the forces is :

(A) $\frac{2\pi}{3}$
(B)

(C)
(D)

111. A 1000 kg car goes from 10 m/s to 20 m/s in 5 sec. The force acting on it is :

(A) 2000 N
(B) 1000 N
(C) 1500 N
(D) 1800 N

112. The maximum velocity of a particle executing simple harmonic motion with an amplitude 7 mm is 4.4 m/sec. The period of oscillation is :

(A) 100 s
(B) 0.01 s
(C) 10 s
(D) 0.1 s

113. A function f(x) is continuous in [0, 1] and differentiable in (0, 1). Then there is a point c in (0, 1) such that $f'(c) =$

(A) $f(1) - f(0)$
(B) $f(0) + f(1)$
(C)
(D) $\frac{f(1) - f(0)}{3}$

114. The power series expansion of sin x is :

(A) $1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + ...$
(B) $x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + ...$
(C) $1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + ...$
(D) None of these

115. If the vector $\bar{i} - \bar{j} + \bar{k}, 3\bar{i} - 4\bar{j} + 5\bar{k}$ and $\bar{i} + 2\bar{j} + t\bar{k}$ are coplanar then the value of t is :

(A) 5
(B) –5
(C) 2
(D) 4

116. If l, m, n are the direction cosines of a line then :

(A) $l^2 + m^2 + n^2 = 0$
(B) $l^2 + m^2 - n^2 = 1$
(C) $l^2 + m^2 + n^2 = 1$
(D) $l^2 - m^2 - n^2 = 1$

117. The distance of the point (1, 1, 4) from the plane $3x - 6y + 2z + 11 = 0$ is :

(A) 3

(B) 4

(C) $\frac{7}{16}$

(D) $\frac{16}{7}$

118. The equation of the sphere with center (0, 0, 0) and radius 1 is :

(A) $x^2 + y^2 - z^2 = 1$

(B) $x^2 - y^2 + z^2 = 1$

(C) $x^3 + y^3 + z^3 = 1$

(D) $x^2 + y^2 + z^2 = 1$

119. If α and β are roots of a quadratic equation $ax^2 + bx + c = 0$, then $\alpha + \beta$ equals :

(A) $\frac{a}{b}$

(B) $\frac{c}{a}$

(C) $-\frac{b}{a}$

(D) $-\frac{a}{b}$

120. The volume of a right circular cone with radius r and height h is given by :

(A) $\pi r^2 h$

(B) $\frac{1}{2}\pi r^2 h$

(C) $\frac{3}{4}\pi rh$

(D) $\frac{1}{3}\pi rh$

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