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Mathematics Test Question Paper of NDA & NA Exam II - 2005

1. If $f(x) = 4x^3 + 3x^2 + 3x + 4$, then what is the value of $x^3 f\left(\frac{1}{x}\right)$?

(a) $f(-x)$ (b) $\frac{1}{f(x)}$

(c) $\left[f\left(\frac{1}{x}\right)\right]^2$ (d) $f(x)$

2. Which one of the following is correct ?
The function $f(x) = \tan x - x$
(a) always decreases
(b) always increases
(c) never decreases
(d) sometimes increases and sometimes decreases

3. To find out the numerical value of $\int_{-2}^{2}(px^2 + qx + s)\,dx$, it is necessary to know the value/values of which of the following ?
(a) p only (b) q only
(c) p and s (d) p, q and s

4. Let $A = (1\ 2\ 3\ 4)$, $M = \begin{pmatrix} 5 \\ 0 \\ 1 \\ -1 \end{pmatrix}$ and $N = \begin{pmatrix} 2 \\ -5 \\ 3 \\ 0 \end{pmatrix}$

What is the value of $A(M+N)$?

(a) $(7\ \ -10\ \ 12\ \ -4)$ (b) $\begin{pmatrix} 7 \\ -10 \\ 12 \\ -4 \end{pmatrix}$

(c) (5) (d) 5

5. $A = [a_{ij}]$, where $a_{ij} = 2i + j \quad 1 \le i \le 3$
$B = [b_{ij}]$, where $b_{ij} = i - 2j \quad 1 \le j \le 2$
$A + B = C$, where $C = \{c_{ij}\}$. What is the value of c_{32} ?
(a) 7 (b) 8
(c) 5 (d) 2

6. Which one of the following is correct ?
The system of equations $x + y + z = 6, 2x + y + z = 3$ and $3x + 2y + 2z = 9$
(a) has no solution
(b) has infinite number of solutions
(c) has only one solution
(d) has only three solutions

7. If $\sin 2A = \lambda \sin 2B$, then what is the value of $\frac{\tan(A+B)}{\tan(A-B)}$?

(a) $\frac{\lambda - 1}{\lambda + 1}$ (b) $\frac{\lambda + 1}{\lambda - 1}$

(c) $\frac{\lambda^2 - 1}{\lambda^2 + 1}$ (d) $\sqrt{\frac{\lambda - 1}{\lambda + 1}}$

8. What is the value of $\tan^{-1} x + \cot^{-1} x$?
(a) $\frac{\pi}{2}$ for $x > 0$ and $-\frac{\pi}{2}$ for $x < 0$
(b) $\frac{\pi}{2}$ for all x
(c) $-\frac{\pi}{2}$ for all x
(d) $\frac{\pi}{2}$ for integral x

9. If the major axis of an ellipse is three times its minor axis, then what is its eccentricity ?

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

(c) $\frac{2}{3}$ (d) $\frac{4}{3}$

10. What is the value of the integral

$$\int e^{\left(\frac{x^2+1}{x}\right)}\,dx - \int \frac{e^{\left(\frac{x^2+1}{x}\right)}}{x^2}\,dx ?$$

(a) $e^x + c$ (b) $e^{\left(\frac{x^2+1}{x}\right)} + c$

(c) $xe^{\left(\frac{x^2+1}{x}\right)} + c$ (d) $\left(x + \frac{1}{x}\right)e^x + c$

11. Consider the following statements :
Vectors which make an angle of $\frac{\pi}{4}$ with the vector $\hat{i} + \hat{j} + \sqrt{2}\hat{k}$ are given by
1. $\hat{i} + \hat{j}$
2. $\hat{i} + \sqrt{2}\hat{k}$
3. $\sqrt{2}\hat{k}$
Which of the statements given above are correct ?
(a) 1, 2 and 3 (b) 1 and 2
(c) 2 and 3 (d) 1 and 3

12. Consider the following statements
If $\vec{u} = \vec{a} - \vec{b} + \vec{c}$, $\vec{v} = 2\vec{a} - 3\vec{b}$ and $\vec{w} = \vec{a} + 3\vec{c}$, then
1. $\vec{u}, \vec{v}, \vec{w}$ are coplanar, if $[\vec{a}, \vec{b}, \vec{c}] = 0$
2. $\vec{u}, \vec{v}, \vec{w}$ are not coplanar, if $[\vec{a}, \vec{b}, \vec{c}] \neq 0$
3. $\vec{u}, \vec{v}, \vec{w}$ are coplanar, if there exist scalars α, β, γ, not all zero such that $\alpha\vec{u} + \beta\vec{v} + \gamma\vec{w} = 0$
Which of the above is/are correct ?
(a) 1 only
(b) 2 only
(c) 3 only
(d) 1 and 3

13. Which one of the following is correct ?

$f(x) = e^{\sin x}$, $x \in (-\pi, \pi)$

(a) is monotonically increasing on $(-\pi, \pi)$
(b) is monotonically increasing on $(-\pi, 0)$
(c) is monotonically decreasing on $(0, \pi)$
(d) is monotonically increasing on $\left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

14. What is the period of the function

$\sin 4x + \tan 2x$?

(a) 2π (b) π
(c) $\frac{\pi}{2}$ (d) $\frac{3\pi}{2}$

15. What is the derivative of $\sin^{-1}\left(\frac{t}{\sqrt{1+t^2}}\right)$ with respect to $\cos^{-1}\left(\frac{1}{\sqrt{1+t^2}}\right)$?

(a) 1 (b) –1
(c) 2 (d) –2

16. For what value of k, does the equation

$9x^2 + y^2 = k(x^2 - y^2 - 2x)$

represent equation of a circle ?

(a) 1 (b) 2
(c) –1 (d) 4

17. Consider families, each having n children and let A be the event that a family has children of both sexes. Assuming that each child has probability $\frac{1}{2}$ of being a boy, what is the value of $P(A)$?

(a) $\frac{1}{2^n}$ (b) $\frac{(n+1)}{2^n}$
(c) $\frac{[2^{(n-1)} - 1]}{2^{(n-1)}}$ (d) $\frac{1}{2^{(n-1)}}$

18. A coin is tossed n times. The probability that the head (H) occurs six times is equal to the probability that the head occurs eight times. What is the value of n ?

(a) 7 (b) 14
(c) 16 (d) 19

19. A determinant is chosen at random from a set of all determinants of order 2 with elements 0 and/or 1 only. What is the probability that the value of the determinant is positive ?

(a) $\frac{3}{16}$ (b) $\frac{5}{16}$
(c) $\frac{1}{16}$ (d) $\frac{13}{16}$

20. What is the maximum possible area that can be enclosed by a wire of length 20 cm by bending it into the form of a sector ?

(a) 25 cm^2 (b) 20 cm^2
(c) 100 cm^2 (d) 144 cm^2

21. Which one of the following is correct ?

$f(x) = \frac{x}{1+|x|}$, $x \in (-\infty, \infty)$

(a) is monotonically increasing at every point of $(-\infty, \infty)$
(b) is monotonically decreasing at every point of $(-\infty, \infty)$
(c) is monotonically increasing on $(-\infty, \infty)$ except at $x = 0$
(d) is monotonically decreasing on $(-\infty, \infty)$ except at $x = 0$

22. If $\theta + \phi = \frac{\pi}{6}$, what is the value of

$(\sqrt{3} + \tan\theta)(\sqrt{3} + \tan\phi)$?

(a) 1 (b) –1
(c) 4 (d) –4

23. What is the value of $\sum_{r=0}^{n/2} {}^nC_{2r}$, if n is even ?

(a) $2^{(n+1)}$ (b) 2^n
(c) $2^{(n-1)}$ (d) $2^{(n-2)}$

24. What is the value of $\sin^2 24° - \sin^2 6°$?

(a) $\frac{\sqrt{5}-1}{4}$ (b) $\frac{\sqrt{5}-1}{8}$
(c) $\frac{\sqrt{5}+1}{8}$ (d) $\frac{\sqrt{5}+1}{4}$

25. What is the value of $z^2 + \bar{z}^2 + 2|z|^2$, if $z = 3 + 2i$?

(a) 36 (b) $81 + 12i$
(c) 39 (d) $40 + 12i$

26. What is the value of $\sin 10° + \sin 50° - \sin 70°$?

(a) 1 (b) 0
(c) $\frac{1}{2}$ (d) 2

27. What is the weighted mean of the first n natural numbers whose weights are equal to the squares of the corresponding numbers ?

(a) $\frac{(n+1)}{2}$ (b) $\frac{3n(n+1)}{2(2n+1)}$
(c) $\frac{(n+1)(2n+1)}{6}$ (d) $\frac{n(n+1)}{2}$

28. Consider the following statements

1. Correlation coefficient is independent of change of origin.
2. Correlation coefficient is independent of change of scale.
3. Regression coefficient is independent of change of origin.
4. Regression coefficient is independent of change of scale.

Which of the statements given above are correct ?

(a) 1, 2 and 3 (b) 1, 2 and 4
(c) 1, 3 and 4 (d) 2, 3 and 4

29. The centre of the circle $(x - \alpha)^2 + (y - \beta)^2 = 9$ lies on the straight line $x = y$, and the circle touches the circle $x^2 + y^2 = 1$ externally. What are the values of α, β ?

(a) $\alpha = \pm 2\sqrt{2}, \beta = \pm 2\sqrt{2}$
(b) $\alpha = \pm \sqrt{2}, \beta = \pm \sqrt{2}$
(c) $\alpha = 0, \beta = 0$
(d) $\alpha = 2, \beta = 2$

30. In a field, 20% of the plants are infected. A random sample of 4 plants is selected. What is the probability that at most 3 plants are infected ?

(a) 0.9984 (b) 0.064

(c) 0.0016 (d) 0.8

31. A body moves in a straight line according to the law $s = t^3 - 4t^2 - 3t$. What are the values of time and acceleration : (time, acceleration); each time when velocity of the body is zero ?

(a) (3, –10) (b) (3, 10)

(c) (2, –10) (d) (2, 10)

32. Which one of the following is correct ?

If $\vec{a}$ and $\vec{b}$ are two non-zero vectors, then the equality

$$|\vec{a} + \vec{b}| = |\vec{a}| + |\vec{b}|$$

(a) never holds

(b) holds, if $\vec{a}$ and $\vec{b}$ make an angle $\frac{\pi}{2}$ with each other

(c) holds, if $\vec{a}$ and $\vec{b}$ are unidirectional

(d) holds, if $\vec{a}$ and $\vec{b}$ make an angle π with each other

33. What is the locus of a moving point equidistant from the straight lines $x + y = 0$ and $x - y = 0$?

(a) $xy = 0$ (b) $xy =$ constant

(c) $x = 0$ (d) $y = 0$

34. The intercepts of a straight line upon the coordinate axes are a and b. If the length of the perpendicular on this line from the origin be 1, then which one of the following relations is correct ?

(a) $\frac{1}{a^2} + \frac{1}{b^2} = 2$ (b) $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{\sqrt{2}}$

(c) $\frac{1}{a^2} + \frac{1}{b^2} = \frac{1}{2}$ (d) $\frac{1}{a^2} + \frac{1}{b^2} = 1$

35. What are the values of x which satisfy the relation $\sin^{-1} x + \sin^{-1}(1 - x) = \cos^{-1} x$?

(a) (0, 1) (b) (–1, 1)

(c) $\left(0, \frac{1}{2}\right)$ (d) $\left(-1, \frac{1}{2}\right)$

36. What is the value of X, if $(1010)_2 \times (111)_2 = (X)_{10}$, ?

(a) 60 (b) 70

(c) 75 (d) 80

37. If $\tan A = \frac{1}{3}$ and $\tan B = \frac{1}{7}$, then what is the value of $2A + B$?

(a) 30° (b) 45°

(c) 60° (d) 135°

38. If $x = (1101)_2$, $y = (110)_2$, then what is $x^2 + y^2$ equal to ?

(a) $(11101011)_2$ (b) $(11001101)_2$

(c) $(111000110)_2$ (d) $(11100101)_2$

39. The sum of the two roots of a quadratic equation is $\sqrt[3]{\lambda}$ and the sum of their squares is $\sqrt[5]{\mu^2}$. Which one of the following is that equation ?

(a) $x^2 - \sqrt[3]{\lambda}x + \left(\sqrt[3]{\lambda^2} - \sqrt[5]{\mu^2}\right) = 0$

(b) $x^2 - \sqrt[3]{\lambda}x + \left(\sqrt[3]{\lambda^2} + \sqrt[5]{\mu^2}\right) = 0$

(c) $2x^2 - 2\sqrt[3]{\lambda}x + \left(\sqrt[3]{\lambda^2} - \sqrt[5]{\mu^2}\right) = 0$

(d) $2x^2 - 2\sqrt[3]{\lambda}x + \left(\sqrt[3]{\lambda^2} + \sqrt[5]{\mu^2}\right) = 0$

40. If $\left(\frac{i}{2} + \frac{\sqrt{3}}{2}\right)^p + \left(\frac{i}{2} - \frac{\sqrt{3}}{2}\right)^q = -1$, then which among the following can be the integral values of p and q, respectively ?

(a) 982, 1160 (b) 829, 1061

(c) 892, 1106 (d) 928, 1016

41. Two finite sets have m and n elements, respectively. The total number of subsets of the first set is 56 more than the total number of subsets of the second set. What are the values of m and n respectively ?

(a) 7, 6 (b) 6, 3

(c) 5, 1 (d) 8, 7

42. The shadow of a pole standing on a horizontal plane is d metre longer when the Sun's altitude is α than when it is β. What is the height of the pole ?

(a) $d\frac{\cos\alpha\cos\beta}{\cos(\alpha - \beta)}$ (b) $d\frac{\sin\alpha\cos\beta}{\sin(\alpha - \beta)}$

(c) $d\frac{\sin\alpha\sin\beta}{\sin(\beta - \alpha)}$ (d) $d\frac{\sin\beta\cos\alpha}{\cos(\alpha + \beta)}$

43. Which one of the following is correct ?

If $\vec{a}$ and $\vec{b}$ are unit vectors, then

(a) it is not possible that both $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are unit vectors

(b) both $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are unit vectors

(c) $\vec{a} + \vec{b}$ is a unit vector but $\vec{a} - \vec{b}$ is a zero vector, if $\vec{a}$ and $\vec{b}$ are parallel

(d) both $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are unit vectors only when $\vec{a}$ and $\vec{b}$ are perpendicular to each other.

44. Consider the following

1. $\int_0^a f(x)\,dx = \int_0^a f(x - a)\,dx$

2. $\int_{-a}^a f(x)\,dx = \int_0^a [f(x) + f(-x)]\,dx$

3. $\int_0^{2a} f(x)\,dx = \int_0^a f(x)\,dx + \int_0^a f(2a - x)\,dx$

4. $\int_a^b f(x)\,dx = \int_a^b f(x - a + b)\,dx$

Which of the above is/are correct ?

(a) 2 only (b) 3 only

(c) 2 and 3 only (d) 1 and 4 only

45. An archway is in the form of a semi-ellipse, the road level coinciding with the major axis. The breadth of the road is 34 ft. A pole of 6 ft height just reaches the top when it is 2 ft from one side of the road. What is the maximum height of the archway in feet ?

(a) 12.75 (b) 12.50

(c) 12.25 (d) 12.00

46. What is the length of the smallest focal chord of the parabola $y^2 = 4ax$?

(a) a (b) $2a$
(c) $4a$ (d) $8a$

47. What is the number of dissimilar terms in the expansion of $(x + y + z)^{10}$?

(a) 11 (b) 33
(c) 55 (d) 66

48. Under which one of the following conditions, the coordinates $(0, 0)$, (h, k), $(h + h', k + k')$ and (h', k'), taken in order will be the vertices of a parallelogram ?

(a) $hh' + kk' = 0$
(b) $hh' - kk' = 0$
(c) It is true for all values of h, h', k and k'
(d) $h = h'$, $k = k'$

49. What is the value of $\frac{1}{2\sin 10^\circ} - 2\sin 70^\circ$?

(a) -1 (b) 1
(c) 0 (d) 2

50. What is the general solution of
$3\tan(\theta - 15^\circ) = \tan(\theta + 15^\circ)$?

(a) $n\pi - \frac{\pi}{4}$, n is non-negative integer

(b) $2n\pi - \frac{\pi}{4}$, n is non-negative integer

(c) $n\pi + \frac{\pi}{4}$, n is non-negative integer

(d) $2n\pi + \frac{\pi}{4}$, n is non-negative integer

51. If $A + B = \frac{\pi}{2}$, what are the greatest and the least values of $\cos A \cos B$ respectively ?

(a) 1/2 and 0
(b) 0 and $-1/2$
(c) 1/2 and $-1/2$
(d) 0 and -1

52. If $\tan p\theta - \tan q\theta = 0$, then the values of θ form a series in

(a) AP (b) GP
(c) HP (d) none of these

53. If $\tan x = b/a$, then what is the value of

$$\sqrt{\frac{a+b}{a-b}} + \sqrt{\frac{a-b}{a+b}} \ ?$$

(a) $\frac{2\sin x}{\sqrt{\sin 2x}}$ (b) $\frac{2\cos x}{\sqrt{\cos 2x}}$
(c) $\frac{2\cos x}{\sqrt{\sin 2x}}$ (d) $\frac{2\sin x}{\sqrt{\cos 2x}}$

54. Consider the following statements in respect of symmetric matrices A and B

1. $A + B$ is symmetric
2. AB is symmetric
3. $AB + BA$ is symmetric
4. $AB - BA$ is symmetric

Which of the statements given above are correct ?

(a) 1 and 2 (b) 1 and 3
(c) 2 and 3 (d) 3 and 4

55. What is the value of

$$\begin{vmatrix} 2\cos^2\frac{\alpha}{2} & \sin\alpha & 1 \\ 2\cos^2\frac{\beta}{2} & \sin\beta & 1 \\ 1 & 0 & 1 \end{vmatrix} ?$$

(a) 0 (b) 1
(c) $\cos(\alpha - \beta)$ (d) $\sin(\beta - \alpha)$

56. If x, y, z are all positive; then what is the value of

$$\begin{vmatrix} 1 & \log_x y & \log_x z \\ \log_y x & 1 & \log_y z \\ \log_z x & \log_z y & 1 \end{vmatrix} ?$$

(a) 1 (b) 3
(c) 0 (d) -2

57. If ω is a cube root of unity and $p = a + b$, $q = a\omega + b\omega^2$, $r = a\omega^2 + b\omega$; then what is the value of pqr ?

(a) $a^2b + ab^2$ (b) $a^2 + ab + b^2$
(c) $a^3 + b^3$ (d) $(a + b)^3$

58. Let D be the determinant of the matrix $\begin{bmatrix} a & b \\ -b & -a \end{bmatrix}$ and D' the determinant of the cofactors of the elements of the matrix. Then which one of the following is correct ?

(a) $D' = D$ (b) $D' = D^2$
(c) $D' = D^3$ (d) $D' = \frac{1}{D}$

59. What is the value of $\tan 10^\circ - \tan 7^\circ - \tan 3^\circ$?

(a) 0
(b) $\tan 20^\circ$
(c) $\tan 10^\circ \tan 7^\circ \tan 3^\circ$
(d) 1

60. Which points on the curve $x^2 = 2y$ are closest to the point $(0, 5)$?

(a) $(\pm 2\sqrt{2}, 4)$ (b) $(\pm 2, 2)$
(c) $(\pm 3, 9/2)$ (d) $(\pm\sqrt{2}, 1)$

61. What is the degree of the differential equation

$$\frac{dy}{dx} + x = \left(y - x\frac{dy}{dx}\right)^{-4} ?$$

(a) 2 (b) 3 (c) 4 (d) 5

62. If $x_0 = C_0$
$x_1 = C_0 + C_1$
$x_2 = C_0 + C_1 + C_2$
$x_3 = C_0 + C_1 + C_2 + C_3$
... ...
what is the value of $x_0 + x_1 + x_2 + x_3 + \ldots + x_{n-1}$, where $C_0, C_1, C_2, C_3, \ldots$ are binomial coefficients ?

(a) $n\,2^{(n-2)}$ (b) $n\,2^{(n-1)}$
(c) $n\,2^n$ (d) $n\,2^{(n+1)}$

63. For what all real values of x, does the function

$$f(x) = \log_{10}(3x - x^2) - \left\{\frac{1}{\log_2 10}\right\} \text{ exist ?}$$

(a) $1 < x < 2$ (b) $1 \le x \le 2$
(c) $x \le 1$ (d) $x \ge 2$

64. If $x = f(t), y = g(t)$, such that $\frac{d^2y}{dx^2} = 0$; which one of the following is correct ?

(a) $\frac{dx}{dt}\frac{d^2y}{dt^2} = \frac{dy}{dt}\frac{d^2x}{dt^2}$ (b) $\frac{d^2x}{dt^2} = \frac{d^2y}{dt^2}$

(c) $\frac{d^2x}{dt^2} + \frac{d^2y}{dt^2} = 0$ (d) $\frac{dx}{dt}\frac{d^2y}{dt^2} + \frac{dy}{dt}\frac{d^2x}{dt^2} = 0$

65. Which one of the following statements is correct ?
The numbers $\log_6 7$, $\log_{42} 7$, $\log_{294} 7$ are in
(a) AP (b) GP
(c) HP (d) none of these

66. Which one of the following statements is correct ?
The natural number $6^{10} - 51$ is
(a) a prime number (b) an even number
(c) divisible by 5 (d) a power of 3

67. What is the value of $7^{6/7}.7^{6/7^2}.7^{6/7^3}$... upto ∞ ?
(a) $\log_7\left(\frac{6}{7}\right)$ (b) ∞
(c) $\frac{6}{7}$ (d) 7

68. Given, $\log_{10} 2 = 0.3010$, what is the number of digits in 20^{64} ?
(a) 81 (b) 82 (c) 83 (d) 84

69. What is the number of solutions of the equation $x^2 - 5|x| + 6 = 0$?
(a) 2 (b) 0 (c) 1 (d) 4

70. If A is the null set and B is an infinite set, then what is $A \times B$?
(a) Infinite set (b) ϕ
(c) Undefined (d) A singleton set

71. If $\bar{x}$, $\bar{y}$ are the means of two distributions such that $\bar{x} < \bar{y}$ and $\bar{z}$ is the mean of the combined distribution; then which one of the following is correct ?
(a) $\bar{x} > \bar{z}$ (b) $\bar{y} < \bar{z}$
(c) $\bar{z} = \frac{\bar{x} + \bar{y}}{2}$ (d) $\bar{x} < \bar{z} < \bar{y}$

Directions : The next four (4) items consist of two statements : one labelled as the **'Assertion (A)'** *and the other as* ***'Reason (R)'****. You are to examine these two statements carefully and select the answer to these items using the code given below*

Code :
(A) Both **A** and **R** are individually true, and **R** is the correct explanation of **A**.
(B) Both **A** and **R** are individually true but **R** is not the correct explanation of **A**.
(C) **A** is true but **R** is false.
(D) **A** is false but **R** is true.

72. **Assertion (A) :** The relation over the set {1, 2, 3, 4} defined by {(1, 3), (2, 3), (1, 4), (2, 4)} is not a map.
Reason (R) : The elements 1 and 2 have no pre-images.
(a) A (b) B
(c) C (d) D

73. **Assertion (A) :** $99^{50} + 100^{50} < 101^{50}$
Reason (R) : $m^n + (m+1)^n < (m+2)^n$ for all $m\, n \in N$
(a) A (b) B (c) C (d) D

74. **Assertion (A) :** $51 \times 52 \times 53 \times 54 \times 55 \times 56 \times 57 \times 58$ is divisible by 40320.
Reason (R) : The product of r consecutive natural numbers is always divisible by r!
(a) A (b) B (c) C (d) D

75. **Assertion (A) :** $f(x) = e^{-|x|}$ is differentiable at $x = 0$.
Reason (R) : $f(x) = e^{-|x|}$ is continuous for all x.
(a) A (b) B (c) C (d) D

76. For three events A, B and C, which one of the following is the simple expression of $(A \cap B) \cap (A \cup B^c) \cap (A^c \cup B)$?
(a) $A^c \cap B$ (b) $A \cup B$
(c) $A \cap B$ (d) $A \cap B^c$

77. What is the locus of the point of intersection of the straight line $x\cos\theta + y\sin\theta = a$ and the straight line $x\sin\theta - y\cos\theta = b$?
(a) A circle (b) An ellipse
(c) A hyperbola (d) A parabola

78. If t is a variable, then what does the curve $x = \frac{a(1-t^2)}{(1+t^2)}$, $y = \frac{2bt}{(1+t^2)}$ represent ?
(a) An ellipse with centre at (0, 0)
(b) An ellipse with centre at (a, b)
(c) A hyperbola with centre at (0, 0)
(d) A hyperbola with centre at (a, b)

79. What is the value of
$\frac{\alpha-\beta}{\alpha} + \frac{1}{2}\left(\frac{\alpha-\beta}{\alpha}\right)^2 + \frac{1}{4}\left(\frac{\alpha-\beta}{\alpha}\right)^3 + \ldots\ldots$ where $0 < \beta < \alpha$?
(a) $\frac{\alpha-\beta}{\alpha}$ (b) $\frac{2(\alpha+\beta)}{\alpha-\beta}$
(c) $\frac{2(\alpha-\beta)}{\alpha+\beta}$ (d) $\frac{\alpha-\beta}{2\beta}$

80. The roots of the equation $x^2 + px + q = 0$ are both real and greater than 1. If $r = p + q + 1$, then which one of the following is correct ?
(a) r must be greater than 0
(b) r must be less than 0
(c) r must be equal to 0
(d) r may be equal to 0

81. What is the value of
$\sin^{-1}\cos\sin^{-1}x + \cos^{-1}\sin\cos^{-1}x$?
(a) $2x$ (b) $\frac{\pi}{2}$
(c) $-\frac{\pi}{2}$ (d) $2x + \pi$

82. If $[x]$ denotes the greatest integer less than or equal to x, then what is the range of the function $f(x) = [x] - x$?
(a) $(-1, 0)$ (b) $[-1, 0]$ (c) $[-1, 0)$ (d) $(-1, 0]$

83. Under which conditions are the two curves $y = x^2 + ax + b$ and $y = cx - x^2$ tangent to each other at the point (1, 0)?

(a) $a = 2, \quad b = -3, \quad c = -1$

(b) $a = 3, \quad b = -4, \quad c = -1$

(c) $a = -1, \quad b = 0, \quad c = 1$

(d) $a = -3, \quad b = 2, \quad c = 1$

84. Match List-I (Angle A) with List-II [(The expression for $2\sin(A/2)$] and select the correct answer using the code given below the Lists :

List-I (Angle A)		List-II [The expression for $2\sin(A/2)$]
A. $340°$	1.	$-\sqrt{1+\sin A}+\sqrt{1-\sin A}$
B. $580°$	2.	$-\sqrt{1+\sin A}-\sqrt{1-\sin A}$
C. $40°$	3.	$\sqrt{1+\sin A}-\sqrt{1-\sin A}$

Code :

	A	B	C		A	B	C
(a)	1	2	3	(b)	1	3	2
(c)	3	2	1	(d)	2	1	3

85. What is the value of $\int_{-\pi/2}^{\pi/2} \frac{\sin x}{x^2}\,dx$?

(a) 1 (b) 0

(c) π (d) -2

86. A particle P moves along the curve $x^2y^3 = 27$ and $\frac{dy}{dt} = 10$ at the time when P is at the point (1, 3). What is the value of $\frac{dx}{dt}$ at that instant?

(a) 5 (b) -10

(c) 10 (d) -5

87. Suppose u and v are functions of x that are differentiable at $x = 0$, and that $u(0) = 5$, $u'(0) = -3$, $v(0) = -1$, $v'(0) = 2$. Then, what is the value of $\frac{d}{dx}\left(\frac{u+v}{uv}\right)$ at $x = 0$?

(a) $\frac{47}{25}$ (b) $-\frac{47}{25}$

(c) $\frac{25}{47}$ (d) $-\frac{25}{47}$

88. If no two vectors of $\vec{a}, \vec{b}$ and $\vec{c}$ are parallel, and $\vec{a} \times \vec{b} = \vec{b} \times \vec{c}$; then which one of the following is correct?

(a) $\vec{a}, \vec{b}, \vec{c}$ are coplanar

(b) $\vec{a} + \vec{b}$ and $\vec{a} + \vec{c}$ are parallel

(c) $\vec{a} + \vec{c}$ and $\vec{b}$ are orthogonal

(d) $\vec{a} + \vec{c}$ and $\vec{b}$ are parallel

89. Which one of the following statements is correct?

$$f(x) = \frac{1}{1+\tan x}$$

(a) is a continuous, real-valued function for all $x \in (-\infty, \infty)$

(b) is discontinuous only at $x = \frac{3\pi}{4}$

(c) has only finitely many discontinuities on $(-\infty, \infty)$

(d) has infinitely many discontinuities on $(-\infty, \infty)$

90. If α, β and γ are distinct non-negative real numbers such that the vectors $\alpha\hat{i}+\alpha\hat{j}+\beta\hat{k}, \hat{i}+\hat{k}$ and $\beta\hat{i}+\beta\hat{j}+\gamma\hat{k}$ are coplanar, then which one of the following is correct?

(a) $\beta^2 = \alpha\gamma$ (b) $\beta = \frac{\alpha+\gamma}{2}$

(c) $\beta = \frac{2\alpha\gamma}{\alpha+\gamma}$ (d) $\alpha = 1, \beta = 0, \gamma = 1$

91. Assume that a particle is displace from the point $A = (2, -6, 1)$ to the point $B = (5, 9, 7)$. If the force applied to move the particle to $\frac{1}{3}$ of the distance from A to B is $\vec{F} = \hat{i} + 2\hat{j} - \hat{k}$ and for the remaining distance it is $\frac{\vec{F}}{3}$; then what is the work done in displacing the particle from A to B?

(a) 9 unit (b) 12 unit

(c) 15 unit (d) 27 unit

92. If a is a real number and z is a complex number, then what is the value of $(z + a)(\bar{z} + a)$?

(a) $z^2 + a^2$ (b) $a^2 - z^2$

(c) $|z - a|^2$ (d) $|z + a|^2$

93. If $ABCD$ is a quadrilateral such that

$$|\vec{BC}| = |\vec{AB}| = |\vec{AD}| = 2|\vec{CD}|,$$

then $\vec{AB} + \vec{BC}$ is equal to?

(a) $2\vec{DC} + \vec{AD}$ (b) $\vec{DC} + \vec{AD}$

(c) $\vec{CD} + \vec{DA}$ (d) $2\vec{CD} + \vec{DA}$

94. $ax^2 + bx + c = 0$ is a quadratic equation such that $a \neq b \neq c$ and $a + b + c = 0$. What is the nature of roots?

(a) Both are positive

(b) Both are negative

(c) They are real and distinct

(d) Both are imaginary

95. Consider the following statements on a set $A = \{1, 2, 3\}$

1. $R = \{(1, 1), (2, 2)\}$ is reflexive relation on A
2. $R = \{(3, 3)\}$ is symmetric and transitive but not a reflexive relation on A

Which of the statements given above is/are correct?

(a) 1 only (b) 2 only

(c) Both 1 and 2 (d) Neither 1 nor 2

96. Let A and B be two events. Then the occurrence of which of the following is represented by

$$(A^c \cap B) \cup (A \cap B^c) \cup (A \cap B)?$$

(a) Exactly one of the two events

(b) At most two of the events

(c) At least one of the two events

(d) None of the two events

97. What is the sum of the integers from 1 to 100 that are divisible by 2 or 5 ?
(a) 3600 (b) 3550
(c) 3050 (d) 2550

98. Which one of the following is correct ?
The equation $x-\left(\frac{7}{x-3}\right)=3-\left(\frac{7}{x-3}\right)$
(a) has only one integral root
(b) has no roots
(c) has two equal integral roots
(d) has two unequal integral roots

99. Let $n \in N$, $n > 25$ and A, G and H denote the arithmetic, geometric and harmonic means of 25 and n respectively. What is the smallest value of n such that A, G, H are in the set $\{25, 26, \ldots, n\}$?
(a) 49 (b) 81
(c) 169 (d) 225

100. If $\cos(\gamma+\delta)\sin(\alpha+\beta)=\cos(\gamma-\delta)\sin(\alpha-\beta)$, then what is the value of $\cot\alpha \cot\gamma \cot\delta$?
(a) $\tan 2\beta$ (b) $\cot 2\beta$
(c) $\tan\beta$ (d) $\cot\beta$

101. If the eccentricity of a conic section is equal to $\frac{x^2}{x^2+1}$, $x \in R\setminus\{0\}$; then the conic section is :
(a) a circle (b) a parabola
(c) an ellipse (d) a hyperbola

102. What is the rate of change of volume of a given sphere of radius r with respect to its surface area ?
(a) r (b) $\frac{r}{2}$
(c) πr (d) $\frac{\pi r}{2}$

103. What is the value of $\lim_{x\to 0}\frac{|x+1|+|x-1|-2}{x}$?
(a) 1 (b) -1
(c) 2 (d) 0

104. If $\int_0^1 x^m(1-x)^n\,dx = K\int_0^1 x^n(1-x)^m\,dx$, what is the value of K ?
(a) 0 (b) 1
(c) -1 (d) 2

105. What is the value of $\int\frac{\sin x}{\sqrt{\sin^2 x-\sin^2\alpha}}\,dx$?
(a) $\sin^{-1}(\sec\alpha\cos x)+c$
(b) $\cos^{-1}(\sec\alpha\cos x)+c$
(c) $\sinh^{-1}(\sec\alpha\cos x)+c$
(d) $\cosh^{-1}(\sec\alpha\cos x)+c$

106. What is the value of $\lim_{x\to 2}\frac{\sqrt{1+\sqrt{2+x}}-\sqrt{3}}{x-2}$?
(a) $\frac{1}{8\sqrt{3}}$
(b) $\frac{1}{4\sqrt{3}}$
(c) 0
(d) The limit does not exist

107. What is the locus of a point which moves such that the difference of the squares of its distances from two given points in space is constant ?
(a) A straight line
(b) A plane
(c) A sphere
(d) Any surface other than a plane or a sphere

108. $P(a, b, c)$; $Q(a+2, b+2, c-2)$ and $R(a+6, b+6, c-6)$ are collinear.
Consider the following statements
1. R divides PQ internally in the ratio 3 : 2.
2. R divides PQ externally in the ratio 3 : 2.
3. Q divides PR internally in the ratio 1 : 2.
Which of the statements given above is/are correct ?
(a) 1 only (b) 2 only
(c) 1 and 3 (d) 2 and 3

109. What is the number of spheres of radius 1 unit which touch the coordinate axes ?
(a) 4 (b) 6
(c) 8 (d) Infinite

110. If (l, m, n) are direction cosines of a line, what is the value of $(l+m-n)^2+(m+n-l)^2+(l+m+n)^2+(n+l-m)^2$?
(a) 0 (b) 1
(c) 4 (d) $4(lm+mn+nl)$

111. What is the sum of digits in the unit place of all numbers formed using 1, 2, 3, 4, 5, 6 taken all at a time without repeating any of them ?
(a) 1260 (b) 2520
(c) 3780 (d) 5040

112. A five-digit number divisible by 3 is to be formed using the digits 0, 1, 2, 3, 4 and 5 without repetition. What is the total number of different ways in which this can be done ?
(a) 216 (b) 212
(c) 240 (d) 600

113. In the triangle ABC, if $b+c=3a$, what is the value of $\cot\frac{B}{2}\cot\frac{C}{2}$?
(a) 1 (b) 2
(c) 3 (d) -2

114. In a football championship, a total of 153 matches was played. Every two teams played one match with each other. What is the total number of teams which took part in the championship ?
(a) 17 (b) 18
(c) 19 (d) 21

115. What is the coefficient of x^n in $(x^2+2x)^{n-1}$?
(a) $(n-1)2^{(n-2)}$ (b) $(n-1)2^{(n-1)}$
(c) $(n-1)2^n$ (d) $n\,2^{(n-1)}$

116. If $A=\begin{bmatrix}3 & 1\\ -1 & 2\end{bmatrix}$ and $A^2+7I_2=5A$, then what is A^{-1} ?
(a) $\frac{1}{7}\begin{bmatrix}2 & -1\\ 1 & 3\end{bmatrix}$ (b) $\frac{1}{7}\begin{bmatrix}2 & 1\\ -1 & 3\end{bmatrix}$
(c) $\frac{1}{7}\begin{bmatrix}2 & -1\\ -1 & 3\end{bmatrix}$ (d) $\frac{1}{7}\begin{bmatrix}-2 & 1\\ -1 & -3\end{bmatrix}$

117. If r_1, r_2 are the roots of the equation $x^2 - px + (p-1) = 0$; for what value of p is the value of $(r_1^2 + r_2^2)$ minimum ?

(a) $p = 0$ (b) $p = -1$
(c) $p = 1$ (d) $p = 2$

118. Which of the following is the correct set of the parametric coordinates of the parabola $y^2 = ax$?

(a) $(at^2, 2at)$ (b) $\left(at^2, \frac{at}{2}\right)$
(c) $\left(\frac{at^2}{4}, -\frac{at}{2}\right)$ (d) $\left(\frac{at^2}{2}, -at\right)$

119. Suppose A is some decimal fraction and B is its binary equivalent. If A is terminating, what can be said about B ?

(a) B must terminate
(b) B must not terminate
(c) B may not terminate
(d) B may not be defined

120. Which one of the following statements is correct ?
The power set of the null set is

(a) null set
(b) a singleton set
(c) a finite set with two or more elements
(d) $\{a^b \mid a \in R, b \in N\}$

Ans: Mathematics

1	(d)
2	(b)
3	(c)
4	(c)
5	(a)
6	(b)
7	(b)
8	(b)
9	(a)
10	(b)
11	(d)
12	(c)
13	(d)
14	(c)
15	(a)
16	(d)
17	(c)
18	(b)
19	(a)
20	(a)
21	(c)
22	(c)
23	(c)
24	(b)
25	(a)
26	(b)
27	(d)
28	(a)
29	(b)
30	(c)
31	(b)
32	(c)
33	(a)
34	(d)
35	(c)
36	(b)
37	(b)
38	(b)

51	(a)
52	(a)
53	(b)
54	(b)
55	(d)
56	(c)
57	(c)
58	(a)
59	(c)
60	(a)
61	(c)
62	(b)
63	(b)
64	(a)
65	(b)
66	(c)
67	(d)
68	(d)
69	(d)
70	(c)
71	(d)
72	(a)
73	(c)
74	(a)
75	(d)
76	(c)
77	(a)
78	(a)
79	(c)
80	(a)
81	(b)
82	(d)
83	(d)
84	(a)
85	(b)
86	(d)
87	(b)
88	(d)

101	(c)
102	(b)
103	(d)
104	(b)
105	(b)
106	(a)
107	(b)
108	(d)
109	(c)
110	(c)
111	(b)
112	(a)
113	(b)
114	(b)
115	(a)
116	(a)
117	(c)
118	(c)
119	(c)
120	(b)

39	(c)	89	(d)
40	(d)	90	(a)
41	(b)	91	(c)
42	(c)	92	(d)
43	(a)	93	(b)
44	(c)	94	(c)
45	(a)	95	(a)
46	(c)	96	(c)
47	(d)	97	(c)
48	(c)	98	(b)
49	(b)	99	(d)
50	(c)	100	(d)