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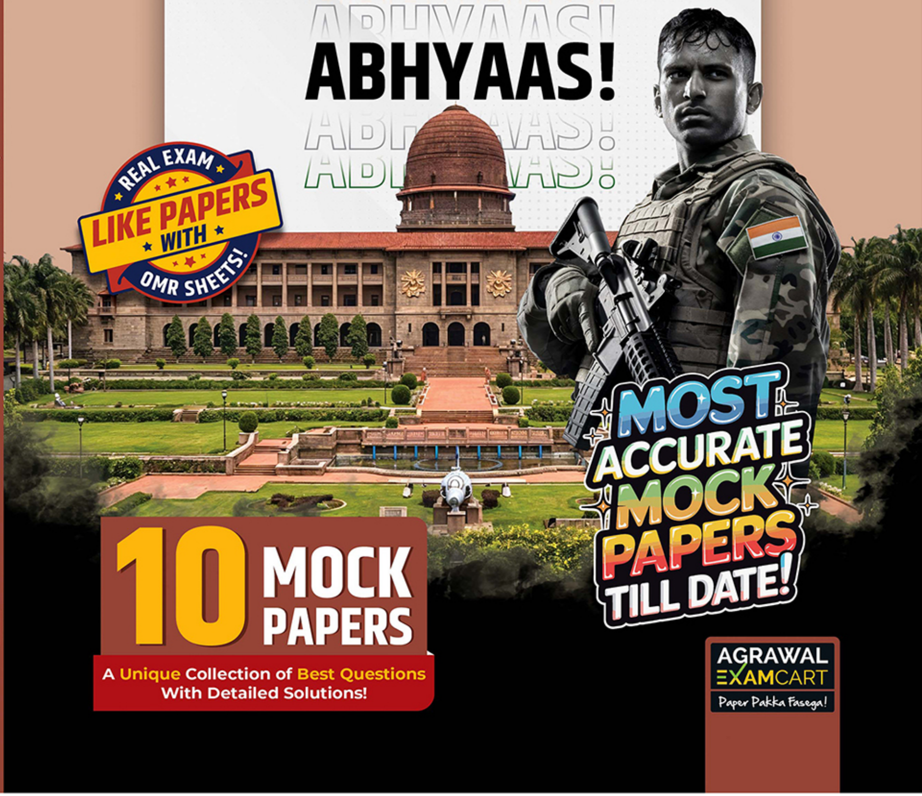

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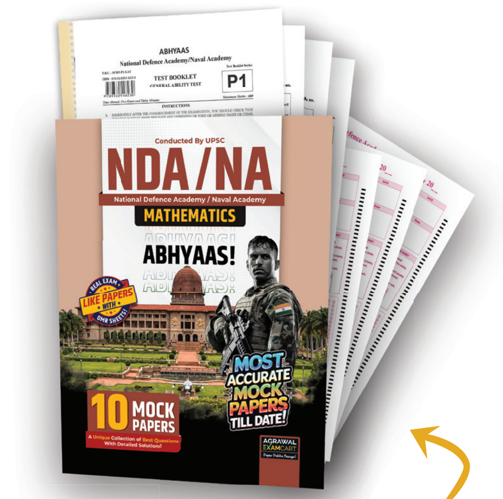

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EXAM PATTERN

PAPER II	MATHEMATICS	TOTAL MARKS
Total No. of Questions	120	300
Marks for Correct Answer	2.5	
Marks for Incorrect Answer	100	
Duration of Exam	2.5 hours	

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TEST BOOKLET

MATHEMATICS

P1

Time Allowed : Two Hours and Thirty Minutes ***Maximum Marks :*** 300

INSTRUCTIONS

1. IMMEDIATELY AFTER THE COMMENCEMENT OF THE EXAMINATION, YOU SHOULD CHECK THAT THIS TEST BOOKLET DOES NOT HAVE ANY UNPRINTED OR TORN OR MISSING PAGES OR ITEMS, ETC. IF SO, GET IT REPLACED BY A COMPLETE TEST BOOKLET.

2. Please note that it is the candidate's responsibility to encode and fill in the Roll Number and Test Booklet Series A, B, C or D carefully and without any omission or discrepancy at the appropriate places in the OMR Answer Sheet. Any omission/discrepancy will render the Answer Sheet liable for rejection.

3. You have to enter your Roll Number on the Test Booklet in the Box provided alongside. DO NOT write anything else on the Test Booklet.

4. This Test Booklet contains **120** items (questions). Each item is printed both in **Hindi** and **English**. Each item comprises four responses (answers). You will select the response which you want to mark on the Answer Sheet. In case you feel that there is more than one correct response, mark the response which you consider the best. In any case, choose ONLY ONE response for each item.

5. You have to mark all your responses ONLY on the separate Answer Sheet provided. See directions in the Answer Sheet.

6. **All** items carry equal marks.

7. Before you proceed to mark in the Answer Sheet the response to various items in the Test Booklet, you have to fill in some particulars in the Answer Sheet as per instructions sent to you with your Admission Certificate.

8. After you have completed filling in all your responses on the Answer Sheet and the examination has concluded, you should hand over to the Invigilator only the Answer Sheet. You are permitted to take away with you the Test Booklet.

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10. **Penalty for wrong answers:**

THERE WILL BE PENALTY FOR WRONG ANSWERS MARKED BY THE CANDIDATE IN THE OBJECTIVE TYPE QUESTION PAPERS.

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Space For Rough Work

Direction (Q. No. 1 to 3)

Every non-zero subset of A × B is defined as a relation from set A to set B. Therefore, if R is a relation from A → B then R = {(*a*, *b*) | (*a*, *b*) ∈ A × B and *a* R *b*}

1. Let A = {1, 2, 3}. The total number of distinct relations that can be defined over A is :

(A) 2^9 (B) 6

(C) 8 (D) None of these

2. Let X = {1, 2, 3, 4, 5} and Y = {1, 3, 5, 7, 9}. Which of the following is not the relations from X to Y :

(A) $R_1 = \{(x, y) | y = 2 + x, x \in X, y \in Y\}$

(B) $R_2 = \{(1, 1), (2, 1), (3, 3), (4, 3), (5, 5)\}$

(C) $R_3 = \{(1, 1), (1, 3) (3, 5), (3, 7), (5, 7)\}$

(D) $R_4 = \{(1, 3), (2, 5), (2, 4), (7, 9)\}$

3. Given two finite sets A and B such that $n(A) = 2$, $n(B) = 3$. Then total number of relations from A to B is :

(A) 4 (B) 8

(C) 64 (D) None of these

4. If $f(x) = \dfrac{\cos^2 x + \sin^4 x}{\sin^2 x + \cos^4 x}$ for $x \in R$, then $f(2002) =$

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

5. In a town of 10,000 families it was found that 40% family buy newspaper A, 20% buy newspaper B and 10% families buy newspaper C, 5% families buy A and B, 3% buy B and C and 4% buy A and C. If 2% families buy all the three newspapers, then number of families which buy A only is :

(A) 3100 (B) 3300 (C) 2900 (D) 1400

6. The number of arrangements of the letters of the word BANANA in which two N's do not appear adjacently is :

(A) 40 (B) 60 (C) 80 (D) 100

7. Which of the following statement(s) is/are correct?

(I) If ${}^{2n}C_2 : {}^{n}C_2 = 9 : 2$ and ${}^{n}C_r = 10$, then $r = 4$

(II) If ${}^{10}C_r = {}^{10}C_{r+2}$, then ${}^{5}C_r$ equals 120

(A) only (I) (B) only (II)

(C) Both (I) and (II) (D) Neither (I) nor (II)

8. In how many ways can 5 boys and 5 girls sit in a circle so that no two boys sit together ?

(A) 5! × 5! (B) 4! × 5!

(C) $\dfrac{5! \times 5!}{2}$ (D) None of these

9. Number of divisors of $n = 38808$ (except 1 and n) is :

(A) 70 (B) 68 (C) 72 (D) 74

10. If $\dfrac{T_2}{T_3}$ in the expansion of $(a + b)^n$ and $\dfrac{T_3}{T_4}$ in the expansion of $(a + b)^{n+3}$ are equal, then $n =$

(A) 3 (B) 4 (C) 5 (D) 6

11. **Statement (I):** Number of roots of the equation $\cot^{-1}x + \cos^{-1}2x + \pi = 0$ is zero.

Statement (II): Range of $\cot^{-1}x$ and $\cos^{-1}x$ is $(0, \pi)$ and $[0, \pi]$, respectively.

(A) Only Statement (I)is true

(B) Only Statement (II) is true

(C) Both Statements (I) and (II) are true

(D) Neither Statement (I) nor Statement (II) are true

12. Let M be a 2 × 2 symmetric matrix with integer entries. Then M is invertible if

I. The first column of M is the transpose of the second row of M.

II. The second row of M is the transpose of the first column of M.

III. M is a diagonal matrix with non-zero entries in the main diagonal.

IV. The product of entries in the main diagonal of M is not the square of an integer.

(A) only statement I (B) only statement IV

(C) I, II and IV (D) III and IV

Direction (Q. No. 13 to 15)

Let $\Delta = \begin{vmatrix} -bc & b^2+bc & c^2+bc \\ a^2+ac & -ac & c^2+ac \\ a^2+ab & b^2+ab & -ab \end{vmatrix}$ and the equation $px^3 + qx^2 + rx + s = 0$ ha roots $a, b, c \in R^+$.

13. The value of Δ is:

(A) $\dfrac{r^2}{p^2}$ (B) $\dfrac{r^3}{p^3}$

(C) $-\dfrac{s}{p}$ (D) None of these

14. The value of Δ is:

(A) $\leq \dfrac{9r^2}{p^2}$ (B) $\geq \dfrac{27s^2}{p^2}$

(C) $\leq \dfrac{27s^2}{p^3}$ (D) None of these

15. If Δ = 27 and $a^2 + b^2 + c^2 = 3$, then:

(A) $3p + 2q = 0$ (B) $4p + 3q = 0$

(C) $3p + q = 0$ (D) None of these

16. Matrix A is such that $A^2 = 2A - I$, where I is the identity matrix. Then for $n \geq 2$. $A^n =$

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

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

17. For how many value(s) of x in the closed interval [–4, –1] i the matrix $\begin{bmatrix} 3 & -1+x & 2 \\ 3 & -1 & x+2 \\ x+3 & -1 & 2 \end{bmatrix}$ singular?

(A) 2 (B) 0

(C) 3 (D) 1

18. In the set of all 3 × 3 real matrices a relation is defined as follows. A matrix A is related to a matrix B if and only if there is a non-singular 3 × 3 matrix P such that $B = P^{-1}AP$. This relation is:

(A) reflexive, symmetric but not transitive
(B) reflexive, transitive but not symmetric
(C) symmetric, transitive but not reflexive
(D) an equivalence relation

19. If $x+y-z=0, 3x-\alpha y-3z=0,\ x-3y+z=0$ has non zero solution, then $\alpha =$

(A) – 1 (B) 0
(C) 1 (D) – 3

20. The number of distinct values of a 2×2 determinant whose entries are from the set {–1,0,1} is:

(A) 3 (B) 4
(C) 5 (D) 6

21. If $\Delta_r = \begin{vmatrix} 2^{r-1} & 2\cdot 3^{r-1} & 4\cdot 5^{r-1} \\ x & y & z \\ 2^n-1 & 3^n-1 & 5^n-1 \end{vmatrix}$, then $\sum_{r=1}^{n} \Delta_r =$

(A) xyz (B) 1
(C) –1 (D) 0

Direction (Q. No. 22 and 23)

Let L_1 and L_2 are the two lines that are mutually perpendicular to each other.

22. If the equations of line L_1 and L_2 are $a_1x+b_1y+c_1=0$ and $a_2x+b_2y+c_2=0$ respectively, then :

(A) $a_1b_2-b_1a_2=0$ (B) $a_1a_2+b_1b_2=0$
(C) $a_1^2b_2+b_1^2a_2=0$ (D) $a_1b_1+a_2b_2=0$

23. If the equations of line L_1 and L_2 are $2x+3ay-1=0$ and $3x+4y+1=0$ respectively, then the value of a will be:

(A) $\frac{1}{2}$ (B) 2
(C) $-\frac{1}{2}$ (D) None of these

24. If the coordinates of the vertices A, B, C of the triangle ABC be $(12,-2)$ and $(8,6)$ respectively, then $\angle B =$

(A) $\tan^{-1}\left(-\frac{6}{7}\right)$ (B) $\tan^{-1}\left(\frac{6}{7}\right)$
(C) $\tan^{-1}\left(-\frac{7}{6}\right)$ (D) $\tan^{-1}\left(\frac{7}{6}\right)$

25. The distance of the point of intersection of the lines $2x-3y+5=0$ and $3x+4y=0$ from the line $5x-2y=0$ is:

(A) $\frac{130}{17\sqrt{29}}$ (B) $\frac{13}{7\sqrt{29}}$
(C) $\frac{130}{17}$ (D) None of these

26. The foot of the coordinates drawn from (2, 4) to the line $x+y=1$ is:

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

27. If the extremities of the base of an isosceles triangle are the points $(2a, 0)$ and $(0, a)$ and the equation of one of the sides is $x = 2a$, then the area of the triangle is:

(A) $5a^2 sq$. units (B) $\frac{5}{2}a^2 sq.$ units
(C) $\frac{25a^2}{2} sq.$ units (D) None of these

Direction (Q. No. 28 to 30)

Consider the circle $x^2 + y^2 = 9$ and the parabola $y^2 = 8x$. They intersect at P and Q in the first and fourth quadrants, respectively. Tangents to the circle P and Q intersect the x-axis at R and the tangents to the parabola at P and Q intersect the x-axis at S.

28. The ratio of areas of triangle PQS and triangle POR is:

(A) 1 : √2 (B) 1 : 2
(C) 1 : 4 (D) 1 : 8

29. The radius of circumcircle of ΔPRS is:

(A) 5 (B) 3√3
(C) 3√2 (D) 2√3

30. The radius of circumcircle of ΔPQR is:

(A) 4 (B) 3
(C) 8/3 (D) 2

31. The locus of mid points of parts in between axes and tangents of ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ will be :

(A) $\frac{a^2}{x^2}+\frac{b^2}{y^2}=1$ (B) $\frac{a^2}{x^2}+\frac{b^2}{y^2}=2$
(C) $\frac{a^2}{x^2}+\frac{b^2}{y^2}=3$ (D) $\frac{a^2}{x^2}+\frac{b^2}{y^2}=4$

32. If a tangent having slope of $-\frac{4}{3}$ to the ellipse $\frac{x^2}{18}+\frac{y^2}{32}=1$ intersects the major and minor axes in points A and B respectively, then the area of ΔOAB is equal to (O is centre of the ellipse):

(A) 12 sq. unit (B) 48 sq. unit
(C) 64 sq. unit (D) 24 sq. unit

33. $\lim_{x\to 1}(1-x)\tan\left(\frac{px}{2}\right) =$

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

34. Let $f(x) = |x-2|$, then which of the following statement(s) is/are correct?

(I) $\lim_{x\to 2+} f(x) = \lim_{x\to 2-} f(x)$

(II) $f(x)$ is continuous at $x=2$

(A) Only (I) (B) Only (II)
(C) Both (I) and (II) (D) Neither (I) nor (II)

35. Let $f(x) = \dfrac{2x^2+7}{x^3+3x^2-x-3}$ be the function. Which of the following statement(s) is/are correct?

(I) The function is continuous on $x=1$ and $x=-1$ but discontinuous on $x=-3$

(II) The function is continuous on $x=1, x=-1, x=-3$

(A) Only (I) (B) Only (II)
(C) Both (I) and (II) (D) Neither (I) nor (II)

36. The value of P for which the function

$$f(x) = \begin{cases} \dfrac{(4^x-1)^3}{\sin\dfrac{x}{p}\log\left[1+\dfrac{x^2}{3}\right]}, & x \neq 0 \\ 12(\log 4)^3, & x=0 \end{cases}$$ may be continuous at $x = 0$, is:

(A) 1 (B) 2
(C) 3 (D) None of these

Direction (Q. No. 37 and 38)

Let $f(x) = \begin{cases} e^x + ax, & x<0 \\ b(x-1)^2, & x \geq 0 \end{cases}$ is differentiable at $x=0$.

37. The value of b is:

(A) –3 (B) 2
(C) 1 (D) –1

38. The value of a is:

(A) –3 (B) 2
(C) 1 (D) –1

39. If f is strictly increasing function, then $\lim_{x\to 0}\dfrac{f(x^2)-f(x)}{f(x)-f(0)}$ is equal to:

(A) 0 (B) 1
(C) –1 (D) 2

Direction (Q. No. 40 and 41)

Let $y = f(x)^{f(x)^{f(x)\ldots\ldots\infty}}$

40. If $f(x) = \sin x$, then $\dfrac{dy}{dx} =$

(A) $\dfrac{y^2 \cot x}{1-y\log\sin x}$ (B) $\dfrac{y^2\cot x}{1+y\log\sin x}$

(C) $\dfrac{y\cot x}{1-y\log\sin x}$ (D) $\dfrac{y\cot x}{1+y\log\sin x}$

41. If $f(x) = x$, then $\dfrac{dy}{dx} =$

(A) $(x^x)^x(1+2\log x)$ (B) $(x^x)^x(1+\log x)$

(C) $x(x^x)^x(1+2\log x)$ (D) $x(x^x)^x(1+\log x)$

42. $\dfrac{d}{dx}\tan^{-1}\left[\dfrac{\cos x-\sin x}{\cos x+\sin x}\right] =$

(A) $\dfrac{1}{2(1+x^2)}$ (B) $\dfrac{1}{1+x^2}$

(C) 1 (D) – 1

43. Which of the following statement(s) is/are correct?

(I): $\int(1+x-x^{-1})e^{x+x^{-1}}\,dx = xe^{x+x^{-1}}+c$

(II): $\int e^{\cos^2 x}\sin 2x\,dx = -e^{\cos^2 x}+c$

(A) Only (I) (B) Only (II)
(C) Both (I) and (II) (D) Neither (I) nor (II)

44. If $\int (\sin 2x+\cos 2x)\,dx = \dfrac{1}{\sqrt{2}}\sin(2x-c)+a$, then the value of a and c is:

(A) $c = \dfrac{\pi}{4}$ and $a=k$ (an arbitrary constant)

(B) $c = -\dfrac{\pi}{4}$ and $a = \dfrac{\pi}{4}$

(C) $c = \dfrac{\pi}{4}$ and a is an arbitrary constant

(D) None of these

Direction (Q. No. 45 and 46)

Suppose we define the definite integral by using the formula

$$\int_a^b f(x)dx = \frac{b-a}{2}\left[f(a)+f(b)\right]$$

For more accurate result for $c\in(a,b)$,

$$F(c) = \frac{c-a}{2}\left[f(a)+f(c)\right]+\frac{b-c}{2}\left[f(b)+f(c)\right]$$

When $c = \dfrac{a+b}{2}$, $\displaystyle\int_a^b f(x)dx = \frac{b-a}{4}\left[f(a)+f(b)+2f(c)\right]$

45. If $f(x)$ is a polynomial and if

$$\lim_{t\to a}\frac{\int_a^t f(x)dx-\dfrac{(t-a)}{2}\left[f(t)+f(a)\right]}{(t-a)^3}=0$$ for all a, then the degree of $f(x)$ can at most be:

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

46. If $f''(x) < 0, \forall (a,b)$ and c is a point such that $a < c < b$ and $[c, f(c)]$ is a point lying on the curve for which $F(c)$ is maximum, then $f'(c) =$

(A) $\frac{f(b)-f(a)}{b-a}$ (B) $\frac{2[f(b)-f(a)]}{b-a}$

(C) $\frac{2f(b)-f(a)}{2b-a}$ (D) None of the above

47. Let $I_1 = \int_0^1 e^{-x}\cos^2 x\,dx$, $I_2 = \int_0^1 e^{-x^2}\cos^2 x\,dx$

$I_3 = \int_0^1 e^{-x^2}dx$, $I_4 = \int_0^1 e^{-x^2/2}dx$.

Statement I: I_1 is the smallest of the given definite integrals.
Statement II: I_3 is the greatest of the given definite integrals.

(A) Only statement I is true
(B) Only statement II is true
(C) Both statements I and II are true
(D) Neither statement I nor statement II is true

48. The area enclosed by the parabola $y^2 = 4ax$ and the straight line $y = 2ax$ is:

(A) $\frac{a^2}{3}$ sq. unit (B) $\frac{1}{3a^2}$ sq. unit

(C) $\frac{1}{3a}$ sq. unit. (D) $\frac{2}{3a}$ sq. unit

Direction (Q. No. 49 to 52)

Let $a\hat{i}+\hat{j}+\hat{k}, \hat{i}+b\hat{j}+\hat{k}, \hat{i}+\hat{j}+c\hat{k}$ be the coplanar vectors, when $(a-1)(b-1)(c-1) \neq 0$.

49. $\frac{1}{a-1}+\frac{1}{b-1}+\frac{1}{c-1}=$

(A) *1* (B) –1
(C) 2 (D) –2

50. $\frac{a+1}{a-1}+\frac{b+1}{b-1}+\frac{c+1}{c-1}=$

(A) 1 (B) –1
(C) 2 (D) –2

51. $\frac{a}{1-a}+\frac{b}{1-b}+\frac{c}{1-c}=$

(A) 1 (B) –1
(C) 2 (D) –2

52. Three forces of magnitudes 1, 2, 3 dynes meet in a point and act along diagonals of three adjacent faces of a cube. The resultant force is:

(A) 114 dyne (B) 6 dyne
(C) 5 dyne (D) None of these

53. The points O, A, B, C, D are such that $\overrightarrow{OA} = \vec{a}$, $\overrightarrow{OB} = \vec{b}$, $\overrightarrow{OC} = 2\vec{a}+3\vec{b}$ and $\overrightarrow{OD} = \vec{a}-2\vec{b}$. If $|\vec{a}| = 3|\vec{b}|$, then the angle between $\overrightarrow{BD}$ and $\overrightarrow{AC}$ is:

(A) $\frac{p}{3}$ (B) $\frac{p}{4}$

(C) $\frac{p}{6}$ (D) None of these

54. Let $\vec{a} = i - j, \vec{b} = j - k, \vec{c} = k - i$. If $\hat{d}$ is a unit vector such that $\vec{a}.\hat{d} = 0 = [\vec{b}\ \vec{c}\ \hat{d}]$, then $\hat{d}$ is equal to:

(A) $\pm\frac{i+j-k}{\sqrt{3}}$ (B) $\pm\frac{i+j+k}{\sqrt{3}}$

(C) $\pm\frac{i+j-2k}{\sqrt{6}}$ (D) $\pm k$

Direction (Q. No. 55 and 56)

Consider the lines L_1: $\frac{(x+1)}{3} = \frac{(y+2)}{1} = \frac{(z+1)}{2}$, L_2: $\frac{(x-2)}{1} = \frac{(y+2)}{2} = \frac{(z-3)}{3}$

55. The unit vector perpendicular to both L_1 and L_2 is:

(A) $\frac{-\hat{i}+7\hat{j}+7\hat{k}}{\sqrt{99}}$ (B) $\frac{-\hat{i}-7\hat{j}+5\hat{k}}{5\sqrt{3}}$

(C) $\frac{-\hat{i}+7\hat{j}+5\hat{k}}{5\sqrt{3}}$ (D) $\frac{7\hat{i}-7\hat{j}-\hat{k}}{\sqrt{99}}$

56. The shortest distance between L_1 and L_2 is:

(A) 0 (B) $\frac{17}{\sqrt{3}}$

(C) $\frac{41}{5\sqrt{3}}$ (D) $\frac{17}{5\sqrt{3}}$

57. If $P \equiv (0,1,0), Q \equiv (0,0,1)$, then projection of PQ on the plane $x+y+z=3$ is:

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

58. The equation of the planes passing through the line of intersection of the planes $3x-y-4z=0$ and $x+3y+6=0$ whose distance from the origin is 1, are:

(A) $x-2y-2z-3=0$, $2x+y-2z+3=0$
(B) $x-2y+2z-3=0$, $2x+y+2z+3=0$
(C) $x+2y-2z-3=0$, $2x-y-2z+3=0$
(D) None of these

59. A box contains 15 tickets numbered 1, 2, …, 15. Seven tickets are drawn at random one after the other with replacement. The probability that the greatest number on a drawn ticket is 9, is:

(A) $\left(\frac{9}{10}\right)^6$ (B) $\left(\frac{8}{15}\right)^7$

(C) $\left(\frac{3}{5}\right)^7$ (D) None of these

60. For two events A and B, if $P(A) = P\left(\frac{A}{B}\right) = \frac{1}{4}$ and $P\left(\frac{B}{A}\right) = \frac{1}{2}$, then:

(A) A and B are independent (B) $P\left(\frac{A'}{B}\right) = \frac{3}{4}$

(C) $P\left(\frac{B'}{A'}\right) = \frac{1}{2}$ (D) All of the above

61. 8 coins are tossed simultaneously. The probability of getting at least 6 heads is:

(A) $\frac{57}{64}$ (B) $\frac{229}{256}$

(C) $\frac{7}{64}$ (D) $\frac{37}{256}$

62. If a dice is thrown 7 times, then the probability of obtaining 5 exactly 4 times is:

(A) ${}^7C_4\left(\frac{1}{6}\right)^4\left(\frac{5}{6}\right)^3$ (B) ${}^7C_4\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right)^4$

(C) $\left(\frac{1}{6}\right)^4\left(\frac{5}{6}\right)^3$ (D) $\left(\frac{1}{6}\right)^3\left(\frac{5}{6}\right)^4$

63. An unbiased dice is rolled and for each number on the dice a bag is chosen:

Number on the dice	Bag Chosen
1	Bag A
2 or 3	Bag B
4 or 5 or 6	Bag C

Bag A contains 3 white ball and 2 black ball, bag B contains 3 white ball and 4 black ball and bag C contains 4 white ball and 5 black balls. Dice is rolled and bag is chosen, if a white ball is chosen, the probability that it is chosen from bag B is:

(A) $\frac{91}{293}$ (B) $\frac{25}{293}$

(C) $\frac{43}{293}$ (D) $\frac{90}{293}$

Direction (Q. No. 64 to 66)

Let X follows a binomial distribution with parameters $n = 6$ and P and $4(P(X = 4)) = P(X = 2)$

64. The value of p is:

(A) $\frac{1}{2}$ (B) $\frac{1}{4}$

(C) $\frac{1}{6}$ (D) $\frac{1}{3}$

65. The mean of number of successes is:

(A) 1 (B) 2

(C) $\frac{2}{3}$ (D) None of these

66. The variance of number of successes is:

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

(C) $\frac{4}{3}$ (D) None of these

67. The value of C for which $P(X = k) = Ck^2$ can serve as the probability function of a random variable X that takes 0, 1, 2, 3, 4 is:

(A) $\frac{1}{30}$ (B) $\frac{1}{10}$

(C) $\frac{1}{3}$ (D) $\frac{1}{15}$

68. If the mean and variance of a binomial variate X are 2 and 1 respectively, then the probability that X takes a value greater than 1, is:

(A) $\frac{2}{3}$ (B) $\frac{4}{5}$

(C) $\frac{7}{8}$ (D) $\frac{15}{16}$

69. At least number of times a fair coin must be tossed so that the probability of getting at least one head is at least 0.8, is:

(A) 7 (B) 6

(C) 5 (D) None of these

70. A biased coin with probability p, $0 < p < 1$, of heads is tossed until a head appears for the first time. If the probability that the number of tosses required is even is $\frac{2}{5}$ then $p =$

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

(C) $\frac{1}{4}$ (D) None of these

71. If $\log_a b = 2$, $\log_b c = 3$ and $\log_c d = 4$, then what is the value of $(abcd)^{1/24}$?

(A) $a^{11/8}$ (B) $a^{13/12}$ (C) $a^{35/24}$ (D) $a^{5/6}$

72. What is $(1001000)_2 \div (1001)_2$ equal to ?

(A) $(1000)_2$ (B) $(1101)_2$ (C) $(1100)_2$ (D) $(1110)_2$

73. If $z_1 = 2 + 2i$ and $z_2 = -2 - 2i$, which of the following statements is true regarding their moduli ?

(A) $|z_1| > |z_2|$

(B) $|z_1| < |z_2|$

(C) $|z_1| = |z_2|$

(D) Modulus cannot be determined

Direction (Q. No. 74 and 75)

Consider the complex number $Z = \frac{1}{5}\begin{vmatrix} 0 & 1 & i \\ 2 & 3i & 1 \\ 1 & 2 & 2i \end{vmatrix} = x + iy$, where $i = \sqrt{-1}$.

74. What is the modulus of Z ?

(A) 2 (B) 1 (C) $\frac{4}{5}$ (D) 5

75. What is the argument of Z ?

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

76. What is the principal argument of $\frac{2+2i}{2-2i}$, where $i = \sqrt{-1}$?

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

77. Let z_1 and z_2 be complex numbers such that $|z_1 + z_2| = |z_1 - z_2|$, find the value of $\text{Re}\left(\frac{z_1}{z_2}\right) + 1$?

(A) 2 (B) 0 (C) 1 (D) – 2

Direction (Q. No. 78 and 79)

Consider the equation $(2 - x)^4 + (4 - x)^4 = 56$

78. What is the number of real roots of the equation ?

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

79. What is the sum of all the roots of the equation ?

(A) 24 (B) 12 (C) 10 (D) 6

80. If the roots of the equation $x^2 - ax - bx - cx + bc + ca = 0$ are equal, then which one of the following is correct ?

(A) $a + b + c = 0$ (B) $a - b + c = 0$

(C) $a + b - c = 0$ (D) $-a + b + c = 0$

81. The roots α and β of a quadratic equation, satisfy the relations $\alpha + \beta = \alpha^2 + \beta^2$ and $\alpha\beta = \alpha^2\beta^2$. What is the number of such quadratic equations ?

(A) 0 (B) 2 (C) 3 (D) 4

82. Let p and q $(p > q)$ be the roots of the quadratic equation $x^2 + bx + c = 0$ where $c > 0$. If $p^2 + q^2 - 9pq = 0$, then what is $p - q$ equal to ?

(A) $7\sqrt{c}$ (B) $\sqrt{7c}$ (C) $3\sqrt{c}$ (D) $\sqrt{3c}$

83. What is the solution of $x \geq 0$, $y \geq 3$ and $x \leq 5$, $y \leq 6$?

(A) $0 \leq x \leq 5, 3 \leq y \leq 6$ (B) $x = 0, y = 3$

(C) $x = 5, y = 6$ (D) $x \geq 0, y \geq 3$

84. If a, b, c, d and p are distinct real numbers such that $(a^2 + b^2 + c^2)p^2 - 2(ab + bc + cd)p + (b^2 + c^2 + d^2) \leq 0$, then a, b, c, d are in:

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

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

85. Let S be the sum, P be the product and R be the sum of the reciprocals of 3 terms of a G.P. Then $\frac{P^2R^3}{S^3}$ is equal to:

(A) 1 (B) $\frac{1}{3}$

(C) 5 (D) 10

86. If the series $S = 1 - 2 + 3 - 4 + \ldots + n$ has $n = 99$, what is S?

(A) 50 (B) 51

(C) 49 (D) 0

87. Let S_n be the sum to n terms of an arithmetic progression 3, 7, 11, … If $40 < \frac{6}{n(n+1)}\sum_{k=1}^{n} S_k < 42$, then n equals:

(A) 11 (C) 7

(C) 9 (D) 8

88. A G..P consists of an even number of terms. If the sum of all the terms is 5 times the sum of terms occupying odd places, then find its common ratio.

(A) 4 (B) $\frac{1}{4}$

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

89. The 10th common term between the series 3 + 7 + 11 + … and 1 + 6 + 11 + … is :

(A) 191 (B) 193

(C) 211 (D) None of these

90. If a, b, c are in A.P,, then which of the following statements is/are true ?

1. a^2, b^2, c^2 may not be in A.P.
2. $a + k, b + k, c + k$ are in AP for any $k \in R$.
3. $a - k, b - k, c - k$ are in AP for any $k \in R$.

Select the correct answer using the code given below :

(A) 1 only (B) 1 and 2 only

(C) 2 and 3 only (D) 1, 2, and 3

91. If $8 = 3 + \frac{1}{4}(3+p) + \frac{1}{4^2}(3+2p) + \frac{1}{4^3}(3+3p) + \ldots \infty$, then the value of p is :

(A) 9 (B) – 1

(C) 6 (D) 0

92. The sum of the series $\frac{1}{1-3\cdot1^2+1^4} + \frac{2}{1-3\cdot2^2+2^4} + \frac{3}{1-3\cdot3^2+3^4} + \ldots$ up to 10 terms is :

(A) $\frac{45}{109}$ (B) $-\frac{45}{109}$

(C) $\frac{55}{109}$ (D) $-\frac{55}{109}$

93. Let x be the HM and y be the GM of two positive numbers m and n. If $5x = 4y$, then which one of the following is correct?

(A) $5m = 4n$ (B) $2m = n$

(C) $4m = 5n$ (D) $m = 4n$

94. The value of tan 9º – tan 27º – tan 63º + tan 81º is :

(A) $2\sqrt{5}+1$ (B) 4

(C) 2 (D) – 4

95. The value of $\cot\frac{\pi}{24}$ is :

(A) $\sqrt{2}+\sqrt{3}+2-\sqrt{6}$ (B) $\sqrt{2}+\sqrt{3}+2+\sqrt{6}$

(C) $\sqrt{2}-\sqrt{3}-2+\sqrt{6}$ (D) $3\sqrt{2}-\sqrt{3}-\sqrt{6}$

96. If $15\sin^4\alpha + 10\cos^4\alpha = 6$, for some $\alpha \in R$, then the value of $27\sec^6\alpha + 8\text{cosec}^6\alpha$ is equal to :

(A) 350 (B) 500

(C) 400 (D) 250

97. The expression $\frac{2+\tan^2 2A+\cot^2 2A}{\sec 2A \cdot \text{cosec} 2A}$ is equal to :

(A) sec 2A + tan 2A (B) sec 2A + cosec 2A

(C) cot 2A – cosec 2A (D) sec 2A cosec 2A

98. If tan θ + sec θ = 4, then find the value of cos θ ?

(A) $\frac{5}{17}$ (B) $\frac{8}{17}$

(C) $\frac{11}{17}$ (D) $\frac{13}{17}$

99. The value of $\cos^2 x+\cos^2\left(x+\frac{\pi}{3}\right)+\cos^2\left(x-\frac{\pi}{3}\right)$ is :

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

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

100. The least value of x for which tan (x + 100º) = tan (x + 50º) tan x tan (x – 50º) is :

(A) 30º (B) 45º

(C) 60º (D) 90º

101. The sides of a triangle are sin α, cos α and $\sqrt{1+\sin\alpha\cos\alpha}$ for some $0 < \alpha < \frac{\pi}{2}$. Then the greatest angle of the triangle is :

(A) 150° (B) 90° (C) 120° (D) 60°

102. A vertical tower stands on a horizontal plane and is surmounted by a vertical flagstaff of height h. At a point on the plane the angles of elevation of the bottom and top of the flagstaff are θand 2θrespectively. What is the height of the tower ?

(A) h cos θ (B) h sin θ

(C) h cos 2θ (D) h sin 2θ

103. Two vertical poles are 150 m apart and the height of one is three times that of the other. If from the middle point of the line joining their feet, an observer finds the angles of elevation of their tops to be complementary, then the height of the shorter pole (in meters) is :

(A) 25 (B) $20\sqrt{3}$

(C) 30 (D) $25\sqrt{3}$

104. If a metallic circular plate of radius 50 cm is heated so that its radius increases at the rate of 1 mm per hour, then the rate at which, the area of the plate increases (in cm^2/hour) is :

(A) 5π (B) 10π (C) 100π (D) 50π

105. The function $f(x) = 1 - x - x^3$ is decreasing for

(A) $x \geq \frac{-1}{3}$ (B) $x < \frac{-1}{3}$

(C) $x > 1$ (D) All values of x

106. For the curve $y = 3\sin\theta\cos\theta$, $x = e^\theta\sin\theta$, $0 \leq \theta \leq \pi$, the tangent is parallel to x-axis when θ is :

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

107. The equation of a normal curve, $\sin y = x\sin\left(\frac{\pi}{3}+y\right)$ at $x = 0$, is :

(A) $2x-\sqrt{3}y = 0$ (B) $2x+\sqrt{3}y = 0$

(C) $2y-\sqrt{3}x = 0$ (D) $2y+\sqrt{3}x = 0$

108. The general solution of the differential equation $\left(xy\frac{dy}{dx}-1\right) = 0$ is :

(A) $xy = \log x + c$ (B) $\frac{x^2}{2} = \log y + c$

(C) $\frac{y^2}{2} = \log x + c$ (D) None of the above

109. What is the degree of the differential equation

$y = x\frac{dy}{dx}+\left(\frac{dy}{dx}\right)^{-2}$?

(A) 1 (B) 3

(C) – 2 (D) Degree does not exist

110. Consider the differential equation :

$$\frac{dy}{dx} = \frac{y^3}{2(xy^2-x^2)}$$

Statement 1 : The substitution $z = y^2$ transforms the above equation into a first order homogeneous differential equation.

Statement 2 : The solution of this differential equation is $y^2e^{-y^2/x} = c.$

Which of above statements are correct ?

(A) 1 only (B) 2 only

(C) Both 1 and 2 (D) Neither 1 nor 2

111. Solution of differential equation $x\,dy - y\,dx = 0$ represents :

(A) a rectangular hyperbola

(B) parabola whose vertex is at origin

(C) straight line passing through origin

(D) a circle whose centre is at origin

112. The differential equation for the family of circle $x^2 + y^2 - 2ay = 0$, where a is an arbitrary constant is :

(A) $(x^2 + y^2)\frac{dy}{dx} = 2xy$ (B) $2(x^2 + y^2)\frac{dy}{dx} = xy$

(C) $(x^2 - y^2)\frac{dy}{dx} = 2xy$ (D) $2(x^2 - y^2)\frac{dy}{dx} = xy$

113. The median of a set of 9 distinct observations is 20.5. If each of the largest 4 observations of the set is increased by 2, then the median of the new set:

(A) remains the same as that of the original set

(B) is increased by 2

(C) is decreased by 2

(D) is two times the original median

114. In a series of $2n$ observations, half of them equal a and remaining half equal $-a$. If the standard deviation of the observations is 2, then $|a|$ equals:

(A) $\frac{\sqrt{2}}{n}$ (B) $\sqrt{2}$

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

115. Consider the following statements :

Statement 1: The variance of first n even natural numbers is $\frac{n^2-1}{4}$

Statement 2: The sum of first n natural numbers is $\frac{n(n+1)}{2}$ and the sum of squares of first n natural numbers is $\frac{n(n+1)(2n+1)}{6}$

Which of above statements is/are correct ?

(A) only 1 (B) only 2

(C) both 1 and 2 (D) neither 1 nor 2

116. If the standard deviation of the numbers 2, 3, a and 11 is 3.5, then which of the following is true ?

(A) $3a^2 - 34a + 91 = 0$ (B) $3a^2 - 23a + 44 = 0$

(C) $3a^2 - 26a + 55 = 0$ (D) $3a^2 - 32a + 84 = 0$

117. From data (–4, 1), (–1, 2), (2, 7) and (3, 1) are regression line of y on x is obtained as $y = a + bx$, then what is the value of $2a + 15b$?

(A) 6 (B) 11

(C) 17 (D) 21

118. If r is the coefficient of correlation between x and y, then what is the correlation coefficient between $(3x + 4)$ and $(-3y + 3)$?

(A) $-r$ (B) r

(C) $\sqrt{3}r$ (D) $-\sqrt{3}r$

119. If the mean deviation about the median of the numbers a, $2a$, $3a$,……, $50a$ is 50, then $|a|$ equals:

(A) 3 (B) 4

(C) 5 (D) 2

120. The mean age of 25 teachers in a school is 40 years. A teacher retires at the age of 60 years and a new teacher is appointed in his place. If now the mean age of the teachers in this school is 39 years, then the age (in years) of the newly appointed teacher is:

(A) 25 (B) 30

(C) 35 (D) 40

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Space For Rough Work

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