WARNING	**Any malpractice or any attempt to commit any kind of malpractice in the Examination will DISQUALIFY THE CANDIDATE.**

PAPER – II MATHEMATICS-2019

Version Code	**B1**	Question Booklet Serial Number :	6127980

Time: 150 Minutes	Number of Questions : 120	Maximum Marks : 480

Name of the Candidate	
Roll Number	
Signature of the Candidate	

INSTRUCTIONS TO CANDIDATES

1. **Please ensure that the VERSION CODE shown at the top of this Question Booklet is same as that shown in the OMR Answer Sheet issued to you.** If you have received a Question Booklet with a different Version Code, please get it replaced with a Question Booklet with the same Version Code as that of OMR Answer Sheet from the Invigilator. **THIS IS VERY IMPORTANT.**
2. Please fill the items such as Name, Roll Number and Signature in the columns given above. Please also write Question Booklet Serial Number given at the top of this page against item 3 in the OMR Answer Sheet.
3. This Question Booklet contains 120 questions. For each question five answers are suggested and given against (A), (B), (C), (D), and (E) of which only one will be the '**Most Appropriate Answer.**' Mark the bubble containing the letter corresponding to the 'Most Appropriate Answer' in the OMR Answer Sheet, by using either **Blue or Black Ball Point Pen only.**
4. **Negative Marking**: In order to discourage wild guessing the score will be subjected to penalization formula based on the number of right answers actually marked and the number of wrong answer marked. Each correct answer will be awarded FOUR marks. ONE mark will be deducted for each incorrect answer. More than one answer marked against a question will be deemed as incorrect answer and will be negatively marked.
5. Please read the instructions in the OMR Answer Sheet for marking the answers. Candidates are advised to strictly follow the instruction contained in the OMR Answer Sheet.

IMMEDIATELY AFTER OPENING THE QUESTION BOOKLET, THE CANDIDATE SHOULD VERIFY WHETHER THE QUESTION BOOKLET CONTAINS ALL THE 120 QUESTIONS IN SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.

DO NOT OPEN THE SEAL UNTIL THE INVIGILATOR ASKS YOU TO DO SO.

SEAL

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PLEASE ENSURE THAT THIS QUESTION BOOKLET CONTAINS 120 QUESTIONS SERIALLY NUMBERED FROM 1 TO 120. PRINTED PAGES 32.

1. The axis of the parabola $x^2 + 6x + 4y + 5 = 0$ is

(A) $x = 0$ (B) $y = 1$ (C) $x + 3 = 0$

(D) $y = 4$ (E) $y + 2 = 0$

2. The distance between the foci of the ellipse $\frac{(x+2)^2}{9} + \frac{(y-1)^2}{4} = 1$ is

(A) $\sqrt{5}$ (B) $2\sqrt{5}$ (C) $3\sqrt{5}$

(D) $9\sqrt{5}$ (E) $7\sqrt{5}$

3. The value of k, if the circles $2x^2 + 2y^2 - 4x + 6y = 3$ and $x^2 + y^2 + kx + y = 0$ cut orthogonally is

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

(D) 5 (E) 1

4. The circle passing through (1, –2) and touching the x-axis at (3, 0) also passes through the point

(A) (2, –5) (B) (–5, –2) (C) (–2, 5)

(D) (–5, 2) (E) (5, –2)

5. If α and β are the roots of the equation $x^2 + \alpha x + \beta = 0$, then

(A) $\alpha = -1, \beta = -2$ (B) $\alpha = 0, \beta = 1$ (C) $\alpha = -2, \beta = 0$

(D) $\alpha = -2, \beta = 1$ (E) $\alpha = 1, \beta = -2$

Space for rough work

6. If $\vec{a} = (1, 1, -1), \vec{b} = (-1, 2, 1)$ and $\vec{c} = (-1, 2, -1)$, then $\left|(\vec{a}+\vec{b})\times(\vec{b}+\vec{c})\right|$ is

(A) 2 (B) 4 (C) 6

(D) 8 (E) 10

7. A particle is displaced from the point (2, 1, –1) to the point (4, 3, –4) by the force $2i + 4j - 5k$. Then the work done by the force is

(A) 16 (B) 27 (C) 36

(D) 48 (E) 52

8. The value of m if the vectors $4i - 3j + 5k$ and $mi - 4j + k$ are perpendicular, is

(A) $\frac{-15}{4}$ (B) $\frac{-17}{4}$ (C) $\frac{-19}{4}$

(D) 0 (E) $\frac{11}{4}$

9. If A and B are two matrices such that $3A + B = \begin{pmatrix} 9 & 11 & 3 \\ 12 & 14 & 19 \end{pmatrix}$ and $2A - 3B = \begin{pmatrix} -16 & 11 & 2 \\ -3 & -22 & 9 \end{pmatrix}$. Then the matrix B is

(A) $\begin{pmatrix} 6 & -1 & 0 \\ 3 & 8 & 1 \end{pmatrix}$ (B) $\begin{pmatrix} 3 & -1 & 0 \\ 2 & 1 & 1 \end{pmatrix}$ (C) $\begin{pmatrix} 8 & 0 & -1 \\ 3 & 1 & 2 \end{pmatrix}$

(D) $\begin{pmatrix} 5 & 3 & -1 \\ 0 & 1 & 2 \end{pmatrix}$ (E) $\begin{pmatrix} 1 & -3 & 4 \\ 3 & 0 & 2 \end{pmatrix}$

Space for rough work

10. If a, b and c are distinct reals and the determinant $\begin{vmatrix} a^3+1 & a^2 & a \\ b^3+1 & b^2 & b \\ c^3+1 & c^2 & c \end{vmatrix} = 0$, then the product abc is

(A) -1 (B) 0 (C) 1

(D) 2 (E) 3

11. If (x, y, z) is the solution of the equations

$$x - y - 2z = 3$$
$$2x + y + 4z = 5$$
$$4x - y - 2z = 11$$

then the value of y equals

(A) 0 (B) $-1/2$ (C) $-1/3$

(D) $-1/4$ (E) -1

12. If $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ is the inverse of the matrix $\begin{pmatrix} 1 & 5 \\ 7 & -3 \end{pmatrix}$, then d equals

(A) $-1/38$ (B) $-7/38$ (C) $3/38$

(D) $5/38$ (E) $9/38$

13. If $f : \mathrm{R} \to \mathrm{R}$ is a function defined by $f(x) = \sin x$, then which of the following is **true**?

(A) f is 1-1 but not onto

(B) f is onto but not 1-1

(C) f is both 1-1 and onto

(D) f is neither 1-1 nor onto

(E) f has finite number of zeros

Space for rough work

14. Consider the set M = {1, 2, 3} along with the relation R = {(1, 2), (1, 1), (3, 1), (3, 4), (3, 3), (4, 3)}. Which of the following statements is **true**?

(A) The relation is symmetric but not transitive

(B) The relation is transitive but not symmetric

(C) The relation is both symmetric and transitive

(D) The relation is neither symmetric nor transitive

(E) The relation is reflexive

15. Let $z_1 = 1 + i\sqrt{3}$ and $z_2 = 1 + i$, then $arg\left(\frac{z_1}{\bar{z}_2}\right)$ is

(A) $\frac{5\pi}{12}$ (B) $\frac{7\pi}{12}$ (C) $\frac{11\pi}{12}$

(D) $\frac{3\pi}{12}$ (E) Not defined

16. The complex number $\sqrt{2}\left[\sin\frac{\pi}{8} + i\cos\frac{\pi}{8}\right]^6$ represents

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

(D) $1 + i$ (E) $1 + 2i$

17. If $z^2 + z + 1 = 0$, where z is a complex number, then the value of

$$\left(z + \frac{1}{z}\right)^2 + \left(z^2 + \frac{1}{z^2}\right)^2 + \left(z^3 + \frac{1}{z^3}\right)^2 + \ldots + \left(z^6 + \frac{1}{z^6}\right)^2 \text{ is}$$

(A) 18 (B) 54 (C) 6

(D) 19 (E) 12

Space for rough work

18. The value of $\tan\left[\sin^{-1}\frac{-1}{\sqrt{2}}\right]$ is

(A) -1 (B) 0 (C) 1
(D) Infinity (E) 2

19. If $\sin^{-1}x + \cos^{-1}2x = \frac{\pi}{6}$, then the value of x is

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

20. If $x = 2\cos t - \cos 2t$ and $y = 2\sin t - \sin 2t$, then $\frac{dy}{dx}$ at $t = \frac{\pi}{2}$ is

(A) -1 (B) 0 (C) 1/2
(D) 1 (E) 3

21. The equation of the tangent to the curve given by $x^2 + 2x - 3y + 3 = 0$ at the point (1, 2) is

(A) $4x - 3y - 2 = 0$ (B) $3y - 4x - 2 = 0$ (C) $4x + 3y + 2 = 0$
(D) $4x + 3y - 2 = 0$ (E) $4y - 3x + 2 = 0$

22. The value of $\lim_{x\to\infty} \frac{x^3 \sin\left(\frac{1}{x}\right) - 2x^2}{1 + 3x^2}$ is

(A) 0 (B) $\frac{1}{3}$ (C) -1
(D) $\frac{-2}{3}$ (E) $\frac{-1}{3}$

Space for rough work

23. The maximum value of $y = \left(\frac{1}{x}\right)^x$, $x > 0$ is

(A) $e^{1/e}$ (B) e^e (C) 1

(D) Infinity (E) 0

24. The value of the integral $\int_0^{\pi} \frac{\cos x}{1+\sin^2 x}\, dx$ is

(A) 0 (B) 1 (C) $\frac{\pi}{2}$

(D) π (E) 2π

25. The area enclosed between the curves $y = 2x^2 + 1$ and $y = x^2 + 5$ is

(A) 4/3 (B) 8/3 (C) 16/3

(D) 32/3 (E) 1/3

26. The solution of the differential equation $5y\, dx = 2x\, dy$ passing through the point (1, 1) is

(A) $2 \ln x = 5 \ln y$ (B) $5 \ln x = 2 \ln y$ (C) $\ln (y + x) = 2$

(D) $\ln (1 + xy) = 0$ (E) $3 \ln x = 5 \ln y$

27. The area of the region bounded by the curves $y = |x - 2|$, $x = 1$, $x = 3$ and $y = 0$ is

(A) 4 (B) 12 (C) 3

(D) 14 (E) 1

Space for rough work

28. If in a frequency distribution, the mean and median are 21 and 22 respectively, then its mode is

(A) 22.0 (B) 20.5 (C) 25.5
(D) 23.2 (E) 24.0

29. For two data sets, each of size 5, the variances are given to be 4 and 5 and the corresponding means are given to be 2 and 4, respectively. The variance of the combined data set is

(A) $\frac{15}{2}$ (B) 6 (C) $\frac{13}{2}$
(D) $\frac{5}{2}$ (E) $\frac{11}{2}$

30. If the mean of the first n odd numbers is $\frac{n^2}{81}$, then n equals

(A) 9 (B) 18 (C) 27
(D) 81 (E) 52

31. A bag contains 5 red balls and some blue balls. If the probability of drawing a blue ball is double that of red ball, the number of blue balls must be

(A) 10 (B) 15 (C) 20
(D) 25 (E) 30

32. A pair of fair dice are rolled together. The probability of getting a total of 8 is

(A) 1/9 (B) 5/36 (C) 7/36
(D) 11/36 (E) 1/36

Space for rough work

33. In a chess tournament, assume that your probability of winning a game is 0.3 against level 1 players, 0.4 against level 2 players and 0.5 against level 3 players. It is further assumed that among the players 50 % are at level 1, 25 % are at level 2 and the remaining are at level 3. Suppose that you win the game. Then the probability that you had played with level 1 player is

(A) 0.3 (B) 0.4 (C) 0.5
(D) 0.6 (E) 0.2

34. A sum of Rs. 280 is to be used to award four prizes. If each prize after the first prize is Rs. 20 less than its preceding prize, then the value of the fourth prize is

(A) 20 (B) 40 (C) 60
(D) 80 (E) 10

35. The coefficient of x^3 in the expansion of $(1+x+2x^2)(1-2x)^5$ is

(A) −20 (B) −40 (C) −60
(D) −80 (E) −100

36. The constant term in the expansion of $\left(x^2-\frac{2}{x}\right)^6$ is

(A) 60 (B) 180 (C) 240
(D) 360 (E) 420

Space for rough work

37. If the equation of the sphere through the circle

$x^2+y^2+z^2=9;\ 2x+3y+4z=5$ and through the point (1, 2, 3)

is $3(x^2+y^2+z^2)-2x-3y-4z=C$, then the value of C is

(A) 11 (B) 22 (C) 36

(D) 41 (E) 54

38. The equation of the plane containing the line $\frac{x-\alpha}{l}=\frac{y-\beta}{m}=\frac{z-\gamma}{n}$ is

$a(x-\alpha)+b(y-\beta)+c(z-\gamma)=0$, where $al+bm+cn$ is equal to

(A) 1 (B) −1 (C) 2

(D) 8 (E) 0

39. Let $f(x)$ and $g(x)$ be two differentiable functions for $0 \le x \le 1$ such that $f(0)=2, g(0)=0, f(1)=6$. If there exists a real number c in (0,1) such that $f'(c)=2g'(c)$, then $g(1)$ is equal to

(A) 0 (B) −1 (C) 4

(D) −2 (E) 2

40. The equation of the tangent to the curve $y=x+\frac{4}{x^2}$ that is parallel to the x-axis is

(A) $y=1$ (B) $y=2$ (C) $y=8$

(D) $y=0$ (E) $y=3$

Space for rough work

41. The number 81 is the coefficient of x^k in the binomial expansion of $\left(x^2 + \frac{3}{x}\right)^4$, $x \neq 0$. Then the value of k equals

(A) –2 (B) 2 (C) –4
(D) 4 (E) 5

42. The possible number of arrangements starting with K of the word KALINGA is

(A) 300 (B) 330 (C) 360
(D) 390 (E) 370

43. A bag contains 3 black and 2 white balls. A ball is drawn at random and is put back in the bag along with one ball of the same colour. A ball is again drawn at random. What is the probability that it is white?

(A) 1/5 (B) 2/5 (C) 1/6
(D) 1/12 (E) 2/13

44. If A and B are two events associated with an experiment such that $P(A \cup B) = P(A \cap B)$, and $P(A) = 1/3$, then P(B) equals

(A) 0 (B) 1/3 (C) 2/3
(D) 1/2 (E) 2/5

45. Three identical fair dice are rolled. The probability that the same number appears on each of them is

(A) 1/3 (B) 1/6 (C) 1/36
(D) 1/216 (E) 1/9

Space for rough work

46. Let $\omega \neq 1$ be a cube root of unity and $(1+\omega)^7 = a+\omega$. Then the value of a is

(A) ω^2 (B) ω (C) 1/2

(D) 1 (E) 0

47. Let $w = \frac{1-iz}{z-i}$. If $|w|=1$, which of the following must be **true**?

(A) z lies inside the unit circle

(B) z lies on real axis

(C) z lies on imaginary axis

(D) z lies outside the unit circle

(E) $Re\, z < 0$

48. For $|z| \geq 2$, if $\left|z+\frac{1}{2}\right| \geq k$, the minimum possible value of k is

(A) 1/2 (B) 3/2 (C) 2

(D) 5/2 (E) 3

49. Let $\cot\theta = -5/12$ where $\frac{\pi}{2} < \theta < \pi$. Then the value of $\sin\theta$ is

(A) $-\frac{12}{13}$ (B) $-\frac{5}{13}$ (C) $\frac{12}{13}$

(D) $\frac{5}{13}$ (E) $\frac{7}{13}$

50. The value of $\tan\frac{\pi}{8}$ is

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

(D) $1-\sqrt{2}$ (E) $-1-\sqrt{2}$

Space for rough work

51. In an A.P., if 5^{th} term is $\frac{1}{7}$ and 7^{th} term is $\frac{1}{5}$, then the sum of first 35 terms is

(A) 9
(B) 18
(C) 36
(D) 72
(E) 83

52. In a G.P., $1, \frac{1}{2}, \frac{1}{4}, ...,$ when the first n number of terms are added, the sum is $\frac{1023}{512}$. Then the value of n is

(A) 10
(B) 12
(C) 14
(D) 16
(E) 18

53. If A.M. and G.M. of the roots of a quadratic equation are 8 and 5 respectively, then the quadratic equation is

(A) $x^2 + 8x + 5 = 0$
(B) $x^2 - 16x + 10 = 0$
(C) $x^2 - 16x + 25 = 0$
(D) $x^2 + 8x + 25 = 0$
(E) $x^2 + 10x + 15 = 0$

54. Given that the equation $x^2 - (2a+b)x + \left(2a^2 + b^2 - b + \frac{1}{2}\right) = 0$ has two real roots. The value of b is

(A) 1
(B) 2
(C) −1
(D) −2
(E) 0

Space for rough work

55. If ${}^5P_r = {}^6P_{r-1}$, then the value of r is

(A) $r = 1$ (B) $r = 5$ (C) $r = 3$

(D) $r = 2$ (E) $r = 4$

56. If ${}^nC_{2017} = {}^nC_{2016}$, then ${}^nC_{4033}$ equals

(A) 1 (B) 2016 (C) 2017

(D) 2033 (E) 2019

57. The image of the point P(2,1) on the straight line $2x - 3y + 1 = 0$ is

(A) $\left(\frac{1}{13}, \frac{25}{13}\right)$ (B) $\left(\frac{15}{13}, \frac{25}{13}\right)$ (C) $\left(\frac{18}{13}, \frac{25}{13}\right)$

(D) $\left(\frac{21}{13}, \frac{25}{13}\right)$ (E) $\left(\frac{11}{13}, \frac{15}{13}\right)$

58. If the centre of the circle inscribed in a square formed by the lines $x^2 - 8x + 12 = 0$ and $y^2 - 14y + 45 = 0$ is (a, b), then $a + b$ is

(A) 11 (B) 9 (C) 7

(D) 5 (E) 4

Space for rough work

59. The equation of the directrix of the parabola $y^2+4y+4x+2=0$ is

(A) $x=-1$ (B) $x=1$ (C) $x=3/2$

(D) $x=-3/2$ (E) $x=2$

60. The foci of the hyperbola $\frac{x^2}{\cos^2\alpha}-\frac{y^2}{\sin^2\alpha}=1$ are

(A) $(\pm 1, 0)$ (B) $(\pm\alpha, 0)$ (C) $(0, \pm 1)$

(D) $(0, \pm\alpha)$ (E) $(1, \pm\alpha)$

61. The domain of definition of the function $f(x)=\frac{\log_3(x+7)}{x^2-5x+6}$ is

(A) $(-7, \infty)\setminus\{3, 2\}$ (B) $(-3, \infty)\setminus\{3, 2\}$ (C) $(-7, \infty)\setminus\{3\}$

(D) $(-3, \infty)\setminus\{3\}$ (E) $(-5, \infty)\setminus\{3\}$

62. Let $f(x)=3x-5$. The inverse of f is given by

(A) $\frac{1}{3x-5}$ (B) $\frac{x+5}{3}$ (C) $\frac{x}{3}-\frac{1}{5}$

(D) $\frac{x}{3}+\frac{1}{5}$ (E) $\frac{3}{x-5}$

Space for rough work

63. Let $R = \{(a,b) : a \le b^2\}$ be a relation on the set of all real numbers. Then R is

(A) symmetric but not transitive
(B) transitive but not symmetric
(C) both symmetric and transitive
(D) neither symmetric nor transitive
(E) having finite range

64. A unit vector $\vec{b}$ is coplanar with $i + j + 2k$ and $i + 2j + k$ and is perpendicular to $i + j + k$. Then $\vec{b}.\, i$ equals

(A) 0 (B) 1 (C) 3/2
(D) 2 (E) 4

65. Suppose $\alpha i + \alpha j + \gamma k$, $i + k$ and $\gamma i + \gamma j + \beta k$ are coplanar where α, β and γ are positive constants. Then the product α β is

(A) γ (B) γ^2 (C) 2γ
(D) $2\gamma^2$ (E) 3γ

66. The area of the triangle whose vertices are $A(1, -1, 2)$, $B(2, 1, -1)$ and $C(3, -1, 2)$ is

(A) $\sqrt{7}$ (B) $\sqrt{11}$ (C) $\sqrt{13}$
(D) $\sqrt{15}$ (E) $\sqrt{10}$

Space for rough work

67. Let $f(x)+2f\left(\frac{1}{x}\right)=\frac{1}{x}-5$. Then $\left|\int_1^2 3f(x)\,dx\right|$ equals

(A) $2+\ln 2$ (B) $2-\ln 2$ (C) 2
(D) $3\ln 2$ (E) $\ln 2$

68. The value of $\lim_{n\to\infty}\left[\frac{1}{n+1}+\frac{1}{n+2}+\cdots+\frac{1}{6n}\right]$ is

(A) $\ln 3$ (B) $\ln 6$ (C) e^3
(D) e^6 (E) $\ln 2$

69. Let $f(x)$ be differentiable and $\int_0^{t^2} x\,f(x)\,dx=\frac{1}{2}t^4$ for all t. Then the value of $f(17)$ is

(A) 17 (B) 1 (C) 1/17
(D) 17/2 (E) 19

70. The value of the definite integral $\int_0^{2\pi}\sqrt{1+\sin\frac{x}{2}}\,dx$ is

(A) $\frac{1}{4}$ (B) $\frac{1}{2}$ (C) $\frac{3}{4}$
(D) 1 (E) $\frac{5}{4}$

71. Let $f(x)=|x-2|$ and $g(x)=f(f(x))$. Then derivative of g at the point $x=5$ is

(A) 1 (B) 2 (C) 4
(D) 5 (E) 0

Space for rough work

72. Let $f(x) = \sin x - \cos x$. Then the value of $\log_{x\to\infty} \dfrac{f(x) - f\left(\frac{\pi}{2}\right)}{x - \frac{\pi}{2}}$ is

(A) 0 (B) $\frac{1}{2}$ (C) $\frac{1}{\sqrt{2}}$

(D) 1 (E) $\sqrt{2}$

73. Let $A = \begin{pmatrix} \alpha & 0 \\ 1 & 1 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 0 \\ 5 & 1 \end{pmatrix}$ be two matrices where α is a real number. Then

(A) $A^2 = B$ for some α (B) $A^2 \neq B$ for any α (C) $A^2 = -B$ for some α

(D) $|A^2| \neq |B|$ for any α (E) $A = -B$ for some α

74. The values of k for which the system

$(k+1)x + 8y = 0$

$kx + (k+3)y = 0$

has unique solution, are

(A) 3, 1 (B) –3, 1 (C) 3, –1

(D) –3, –1 (E) 1, –1

Space for rough work

75. If M and N are square matrices of order 3 where det(M) = 2 and det(N) = 3, then det(3MN) is

(A) 27 (B) 81 (C) 162
(D) 324 (E) 121

76. If the lines $\frac{x+3}{-3} = \frac{y-1}{k} = \frac{z-5}{5}$ and $\frac{x+1}{-1} = \frac{y-2}{2} = \frac{z-5}{5}$ are coplanar, then the value of k is

(A) 1 (B) 2 (C) 3
(D) 4 (E) 5

77. A plane passes through the point P(1, –2, 1) and is perpendicular to two planes $2x - 2y + z = 0$ and $x - y + 2z = 4$. Then the equation of the plane is

(A) $x + y + 1 = 0$ (B) $x - y + 1 = 0$ (C) $x + 2y + 1 = 0$
(D) $x - 2y + 1 = 0$ (E) $x - y - 1 = 0$

78. The differential equation which represents the family of curves $y^2 = 2c(x + \sqrt{c})$ where $c > 0$, is of

(A) order 2 (B) degree 2 (C) order 3
(D) degree 3 (E) degree 1

79. The number of solutions of the differential equation $\frac{dy}{dx} = y^{1/3}$ which are passing through the origin, is

(A) 0 (B) 1 (C) 2
(D) 3 (E) 5

Space for rough work

80. If $\frac{dy}{dx} = \frac{2}{x+y}$ and $y(1) = 0$, then $x + y + 2$ equals

(A) $3e^{\left(\frac{y}{2}\right)}$ (B) $2e^{\left(\frac{y}{2}\right)}$ (C) $e^{\left(\frac{y}{2}\right)}$

(D) 0 (E) $5e^{\left(\frac{y}{2}\right)}$

81. The length of the latus rectum of the parabola $(x+2)^2 = -14(y-5)$ is

(A) 7 (B) 14 (C) 21

(D) 28 (E) 17

82. One of the foci of the hyperbola $\frac{x^2}{9} - \frac{y^2}{16} = 1$ is

(A) (3, 0) (B) (4, 0) (C) (5, 0)

(D) (9, 0) (E) (2, 0)

83. If the circles $x^2 + y^2 - 8x - 6y + c = 0$ and $x^2 + y^2 - 2y + d = 0$ cut orthogonally, then $c + d$ equals

(A) 6 (B) 4 (C) 2

(D) 0 (E) 1

84. The points with position vector $60\hat{i} + 3\hat{j}, 40\hat{i} - 8\hat{j}$ and $a\hat{i} - 52\hat{j}$ are collinear if

(A) $a = -10$ (B) $a = 40$ (C) $a = 20$

(D) $a = 10$ (E) $a = -40$

Space for rough work

85. The area enclosed within the curve $|x| + |y| = 1$ is

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

(D) $2\sqrt{2}$ (E) 2

86. The unit vector in the direction of the vector $\overline{AB}$ if $A=(-2,-1,3)$ and $B=(1,1,0)$ is $\alpha i + \beta j + \gamma k$, then $\alpha + \beta$ is

(A) $\frac{3}{\sqrt{22}}$ (B) $\frac{5}{\sqrt{22}}$ (C) $\frac{-3}{\sqrt{22}}$

(D) $\frac{-5}{\sqrt{22}}$ (E) $\frac{2}{\sqrt{22}}$

87. If $\begin{pmatrix} 3x-y & x+3y \\ 2x-z & 2y+z \end{pmatrix} = \begin{pmatrix} 7 & 9 \\ 5 & 5 \end{pmatrix}$, then $x+y+z$ equals

(A) 3 (B) 6 (C) 9

(D) 12 (E) 11

88. If the product $abc = 1$, then the value of the determinant $\begin{vmatrix} -a^2 & ab & ac \\ ba & -b^2 & bc \\ ac & bc & -c^2 \end{vmatrix}$ is

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

(D) 4 (E) 5

Space for rough work

89. If (x, y, z) is the solution of the equations

$4x + y = 7$

$3y + 4z = 5$

$5x + 3z = 2$

Then the value of $x + y + z$ equals

(A) 8 (B) 6 (C) 3

(D) 0 (E) 1

90. If $\begin{pmatrix} e & f \\ g & h \end{pmatrix}$ is the inverse of the matrix $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ where $ad - bc = 1$, then g equals

(A) c (B) $-c$ (C) b

(D) $-b$ (E) d

91. If $f : \mathrm{R} \to \mathrm{R}$ is a function defined by $f(x) = x^2$, then which of the following is **true**?

(A) f is 1-1 but not onto

(B) f is onto but not 1-1

(C) f is neither 1-1 nor onto

(D) f is both 1-1 and onto

(E) $f^{-1} : \mathrm{R} \to \mathrm{R}$ exists

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92. Consider the set A = {1, 2, 3} along with the relation R = {(1, 1), (2, 2), (1, 2), (2, 1), (3, 3)}. Which of the following statements is **true**?

(A) The relation is symmetric but not transitive

(B) The relation is transitive but not symmetric

(C) The relation is neither symmetric nor transitive

(D) The relation is both symmetric and transitive

(E) The relation is a function

93. If $(-\sqrt{3}-i)^{30} = -4^k$, then the value of k is

(A) 15 (B) 20 (C) 25

(D) 30 (E) 60

94. If ω is an imaginary cube root of unity, then $(1+\omega-\omega^2)^7$ is equal to

(A) $128\,\omega$ (B) $-128\,\omega$ (C) $128\,\omega^2$

(D) $-128\,\omega^3$ (E) $-128\,\omega^2$

95. The value of $\left[\cos\frac{\pi}{8}+i\sin\frac{\pi}{8}\right]^4$ is

(A) $-i\pi$ (B) $i\pi$ (C) i

(D) $-i$ (E) π

96. If $arg(\overline{z}_1) = arg(z_2)$, then

(A) $z_2 = kz_1^{-1}, (k>0)$ (B) $z_2 = kz_1, (k>0)$ (C) $|z_2| = |\overline{z}_1|$

(D) $z_1 = z_2$ (E) $|z_2| = |z_1|$

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97. The value of $\tan\left[\sin^{-1}\frac{5}{13}+\cot^{-1}\frac{4}{3}\right]$ is

(A) 26/11 (B) 56/33 (C) 63/41

(D) 65/43 (E) 32/13

98. If $\tan^{-1}x+2\cot^{-1}x=\frac{\pi}{3}$, then the value of x is

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

(D) $\sqrt{3}$ (E) $\sqrt{5}$

99. Which of the following is not a solution of the equation $3\tan^2\theta-\sin\theta=0$?

(A) $n\pi$ (B) $n\frac{\pi}{2}$ (C) $n\pi+(-1)^n\frac{\pi}{6}$

(D) 0 (E) π

Space for rough work

100. If $\sqrt{\frac{y}{x}} + \sqrt{\frac{x}{y}} = 1$, then $\frac{dy}{dx}$ equals

(A) $\sqrt{\frac{y}{x}}$ (B) $\sqrt{\frac{x}{y}}$ (C) $\frac{y}{x}$

(D) $\frac{x}{y}$ (E) xy

101. If $x = \frac{3t}{1+t^3}$ and $y = \frac{3t^2}{1+t^3}$, then $\frac{dy}{dx}$ at $t = 1$ equals

(A) -6 (B) -1 (C) 1

(D) 6 (E) 4

102. The equation of the normal to the curve given by $x^2 + 2x - 3y + 3 = 0$ at the point (1, 2) is

(A) $3x + 4y - 11 = 0$ (B) $3x - 4y + 11 = 0$ (C) $-3x + 4y - 11 = 0$

(D) $3x - 4y - 11 = 0$ (E) $-3x - 4y - 11 = 0$

103. A point of inflection of the curve given by $y = x^3 - 6x^2 + 12x + 50$ occurs when

(A) $x = 2/3$ (B) $x = 3/2$ (C) $x = 2$

(D) $x = 3$ (E) $x = 0$

Space for rough work

104. The value of the integral $\int_0^{\frac{\pi}{2}} \log \tan\theta \, d\theta$ is

(A) 0 (B) 1 (C) $\frac{\pi}{2}$

(D) log 2 (E) 2

105. The area enclosed between the curve $y = 11x - 24 - x^2$ and the line $y = x$ is

(A) 1/3 (B) 3/4 (C) 1

(D) 4/3 (E) 1/2

106. The solution of the differential equation $\frac{dy}{dx} = \frac{y^2}{x}$ passing through the point $(1, -1)$ is

(A) $\frac{1}{y} + \log x = 0$ (B) $\frac{1}{y} - \log x = 0$ (C) $y + \log x = 0$

(D) $y - \log x = 0$ (E) $y \log x = 0$

107. The maxima and minima of the function $2x^3 - 15x^2 + 36x + 10$ occur respectively at

(A) $x = 1, x = 3$ (B) $x = 2, x = 1$ (C) $x = 3, x = 2$

(D) $x = 1, x = 2$ (E) $x = 2, x = 3$

Space for rough work

108. In a class of 100 students, there are 70 boys whose average marks in a subject are 75. If the average marks of the complete class is 72, then what is the average of the girls?

(A) 73 (B) 85 (C) 68
(D) 74 (E) 65

109. Let $x_1, x_2, ..., x_n$ be n observations such that $\sum x_i^2 = 400$ and $\sum x_i = 80$. Then a possible value of n is

(A) 15 (B) 10 (C) 9
(D) 12 (E) 18

110. If M and N are events such that $P(M \cup N) = \frac{3}{4}$, $P(M \cap N) = \frac{1}{4}$, $P(\bar{M}) = \frac{2}{3}$, then $P(\bar{M} \cap N)$ is

(A) $\frac{15}{12}$ (B) $\frac{3}{8}$ (C) $\frac{5}{8}$
(D) $\frac{1}{4}$ (E) $\frac{5}{12}$

Space for rough work

111. Cards marked with numbers 2 to 105 are placed in a box and mixed. One card is chosen at random. The probability that the number on the card is less than 15 is

(A) 1/8 (B) 1/9 (C) 7/8
(D) 8/9 (E) 2/7

112. An urn contains 4 black, 5 white and 6 red balls. One ball is drawn at random. The probability that it is not black is

(A) 4/15 (B) 9/15 (C) 11/15
(D) 13/15 (E) 14/15

113. In a chess tournament, assume that your probability of winning a game is 0.3 against level 1 players, 0.4 against level 2 players and 0.5 against level 3 players. It is further assumed that among the players 50% are at level 1, 25 % are at level 2 and the remaining are at level 3. The probability of winning a game against a randomly chosen player is

(A) 0.275 (B) 0.375 (C) 0.225
(D) 0.325 (E) 0.125

114. A man repays a loan of Rs. 3250 by paying Rs. 20 in the first month and then increases the payment by Rs.15 every month. The number of months it takes to clear the loan is

(A) 20 (B) 25 (C) 35
(D) 40 (E) 10

Space for rough work

115. The coefficient of x^3 in the expansion of $\left(x^2 - \frac{2}{x}\right)^6$ is

(A) –160 (B) –80 (C) –40

(D) 0 (E) –10

116. If the equation of the sphere through the circle

$x^2 + y^2 + z^2 = 5;\ 2x + 3y + 4z = 5$ and through the origin is

$x^2 + y^2 + z^2 - 2x - 3y - 4z + C = 0$ then the value of C is

(A) 1 (B) –1 (C) 0

(D) 5 (E) 2

117. The equation of the plane containing the lines

$\frac{x+1}{3} = \frac{y+3}{5} = \frac{z+5}{7}$ and $\frac{x-2}{1} = \frac{y-4}{3} = \frac{z-6}{5}$ is

(A) $x + 2y + z = 0$ (B) $x - 2y + z = 0$ (C) $x - 2y - z = 0$

(D) $x + 2y - z = 0$ (E) $2y - x - z = 0$

Space for rough work

118. A value of c for which the conclusion of mean value theorem holds for the function $f(x) = \log_e x$ on the interval [1, 3] is

(A) $8\log_3 e$ (B) $\frac{1}{2}\log_e 3$ (C) $\log_3 e$

(D) $\log_e 3$ (E) $2\log_3 e$

119. From 4 men and 6 ladies a committee of five is to be selected. The number of ways in which the committee can be formed so that men are in majority is

(A) 68 (B) 156 (C) 60

(D) 72 (E) 66

120. The degree of the differential equation $\left[1+\left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}} = l\frac{d^2y}{dx^2}$ is

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

(D) 4 (E) 5

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