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

# PAPER –II MATHEMATICS-2017

| Version code | B1 | Question Booklet Serial Number : | 2132728 |
|---|---|---|---|

| 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 instructions 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 THE SERIAL ORDER. IF NOT, REQUEST FOR REPLACEMENT.**

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

SEAL

BLANK PAGE

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

**1.** $\begin{vmatrix} 1 & 1 & 1 \\ p & q & r \\ p & q & r+1 \end{vmatrix}$ is equal to

(A) $q-p$ (B) $q+p$ (C) $q$ (D) $p$ (E) 0

**2.** Let $A = \begin{bmatrix} 5 & 0 \\ 1 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$. If 4A + 5B – C = 0, then C is

(A) $\begin{bmatrix} 5 & 25 \\ -1 & 0 \end{bmatrix}$ (B) $\begin{bmatrix} 20 & 5 \\ -1 & 0 \end{bmatrix}$ (C) $\begin{bmatrix} 5 & -1 \\ 0 & 25 \end{bmatrix}$ (D) $\begin{bmatrix} 5 & 25 \\ -1 & 5 \end{bmatrix}$ (E) $\begin{bmatrix} 0 & 5 \\ 5 & 25 \end{bmatrix}$

**3.** If $U = \begin{pmatrix} \frac{1}{\sqrt{2}} & \frac{-1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} & \frac{1}{\sqrt{2}} \end{pmatrix}$, then $U^{-1}$ is

(A) $U^T$ (B) U (C) I (D) 0 (E) $U^2$

**4.** If $A = \begin{pmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix}$, then $A^{-1}$ is

(A) $A^T$ (B) $A^2$ (C) A (D) I (E) 0

Space for rough work

5. If $\begin{pmatrix} x+y & x-y \\ 2x+z & x+z \end{pmatrix} = \begin{pmatrix} 0 & 0 \\ 1 & 1 \end{pmatrix}$, then the values of $x$, $y$ and $z$ are respectively

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

6. $\begin{pmatrix} 7 & 1 & 5 \\ 8 & 0 & 0 \end{pmatrix}\begin{pmatrix} 2 \\ 3 \\ 1 \end{pmatrix} + 5\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ is equal to

(A) $\begin{pmatrix} 16 \\ 27 \end{pmatrix}$ (B) $\begin{pmatrix} 27 \\ 16 \end{pmatrix}$ (C) $\begin{pmatrix} 15 \\ 16 \end{pmatrix}$ (D) $\begin{pmatrix} 16 \\ 15 \end{pmatrix}$ (E) $\begin{pmatrix} 16 \\ 16 \end{pmatrix}$

7. If $\begin{pmatrix} 1 & 2 & 4 \\ 1 & 3 & 5 \\ 1 & 4 & a \end{pmatrix}$ is singular, then the value of $a$ is

(A) $a = -6$ (B) $a = 5$ (C) $a = -5$ (D) $a = 6$ (E) $a = 0$

8. If $\begin{pmatrix} 1 & 2 & -3 \\ 0 & 4 & 5 \\ 0 & 0 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}$, then $(x, y, z)$ is equal to

(A) (1, 6, 6) (B) (1, –6, 1) (C) (1, 1, 6) (D) (6, –1, 1) (E) (–1, 6, 1)

Space for rough work

**9.** If $A = \begin{pmatrix} 1 & 5 \\ 0 & 2 \end{pmatrix}$, then

(A) $A^2-2A+2I=0$

(B) $A^2-3A+2I=0$

(C) $A^2-5A+2I=0$

(D) $2A^2-A+I=0$

(E) $A^2+3A+2I=0$

**10.** If $\begin{pmatrix} 2x+y & x+y \\ p-q & p+q \end{pmatrix}=\begin{pmatrix} 1 & 1 \\ 0 & 0 \end{pmatrix}$, then $(x, y, p, q)$ equals

(A) $0, 1, 0, 0$ (B) $0, -1, 0, 0$ (C) $1, 0, 0, 0$ (D) $0, 1, 0, 1$ (E) $1, 0, 1, 0$

**11.** The value of $\left|\sqrt{4+2\sqrt{3}}\right|-\left|\sqrt{4-2\sqrt{3}}\right|$ is

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

**12.** The value of $8^{2/3}-16^{1/4}-9^{1/2}$ is

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

**13.** Let $x=2$ be a root of $y=4x^2-14x+q=0$. Then $y$ is equal to

(A) $(x-2)(4x-6)$

(B) $(x-2)(4x+6)$

(C) $(x-2)(-4x-6)$

(D) $(x-2)(-4x+6)$

(E) $(x-2)(4x+3)$

Space for rough work

14. If $x_1$ and $x_2$ are the roots of $3x^2-2x-6=0$, then $x_1^2+x_2^2$ is equal to

(A) $\frac{50}{9}$ (B) $\frac{40}{9}$ (C) $\frac{30}{9}$ (D) $\frac{20}{9}$ (E) $\frac{10}{9}$

15. Let $x_1$ and $x_2$ be the roots of the equation $x^2+px-3=0$. If $x_1^2+x_2^2=10$, then the value of $p$ is equal to

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

16. If the product of roots of the equation $mx^2+6x+(2m-1)=0$ is −1, then the value of $m$ is

(A) $\frac{1}{3}$ (B) 1 (C) 3 (D) −1 (E) −3

17. If $f(x)=\frac{1}{x^2+4x+4}-\frac{4}{x^4+4x^3+4x^2}+\frac{4}{x^3+2x^2}$, then $f\left(\frac{1}{2}\right)$ is equal to

(A) 1 (B) 2 (C) −1 (D) 3 (E) 4

Space for rough work

**18.** If $x$ and $y$ are the roots of the equation $x^2+bx+1=0$, then the value of $\frac{1}{x+b}+\frac{1}{y+b}$ is

(A) $\frac{1}{b}$ (B) $b$ (C) $\frac{1}{2b}$ (D) $2b$ (E) 1

**19.** The equations $x^5+ax+1=0$ and $x^6+ax^2+1=0$ have a common root. Then $a$ is equal to

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

**20.** The roots of $ax^2+x+1=0$, where $a\neq0$, are in the ratio 1:1. Then $a$ is equal to

(A) $\frac{1}{4}$ (B) $\frac{1}{2}$ (C) $\frac{3}{4}$ (D) 1 (E) 0

**21.** If $z^2+z+1=0$ where $z$ is a complex number, then the value of $\left(z+\frac{1}{z}\right)^2+\left(z^2+\frac{1}{z^2}\right)^2+\left(z^3+\frac{1}{z^3}\right)^2$ equals

(A) 4 (B) 5 (C) 6 (D) 7 (E) 8

---

Space for rough work

**22.** Let $\Delta = \begin{vmatrix} 1 & 1 & 1 \\ 1 & -1-w^2 & w^2 \\ 1 & w & w^4 \end{vmatrix}$, where $w \neq 1$ is a complex number such that $w^3 = 1$.

Then $\Delta$ equals

(A) $3w+w^2$ (B) $3w^2$ (C) $3(w-w^2)$ (D) $-3w^2$ (E) $3w^2+1$

**23.** If $\begin{vmatrix} 3i & -9i & 1 \\ 2 & 9i & -1 \\ 10 & 9 & i \end{vmatrix} = x+iy$, then

(A) $x=1, y=1$

(B) $x=0, y=1$

(C) $x=1, y=0$

(D) $x=0, y=0$

(E) $x=-1, y=0$

**24.** If $z = \cos\left(\frac{\pi}{3}\right) - i\sin\left(\frac{\pi}{3}\right)$, then $z^2-z+1$ is equal to

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

---

Space for rough work

25. $\left(\dfrac{1+\cos\left(\frac{\pi}{12}\right)+i\sin\left(\frac{\pi}{12}\right)}{1+\cos\left(\frac{\pi}{12}\right)-i\sin\left(\frac{\pi}{12}\right)}\right)^{72}$ is equal to

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

26. If $A = \begin{vmatrix} 4 & k & k \\ 0 & k & k \\ 0 & 0 & k \end{vmatrix}$ and $det$ (A) = 256, then $|k|$ equals

(A) 4 (B) 5 (C) 6 (D) 7 (E) 8

27. If $A = \begin{pmatrix} 1 & 0 \\ 1 & 1 \end{pmatrix}$, then $A^n + nI$ is equal to

(A) I (B) $nA$ (C) $I+nA$ (D) $I-nA$ (E) $nA-I$

28. If $|z| = 5$ and $w = \frac{z-5}{z+5}$, then Re($w$) is equal to

(A) 0 (B) $\frac{1}{25}$ (C) 25 (D) 1 (E) −1

---

Space for rough work

**29.** If $A = \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}$, then $A^{2017}$ is equal to

(A) $2^{2015} A$ (B) $2^{2016} A$ (C) $2^{2014} A$ (D) $2^{2017} A$ (E) $2^{2020} A$

**30.** If $a = e^{i\theta}$, then $\frac{1+a}{1-a}$ is equal to

(A) $\cot\frac{\theta}{2}$ (B) $\tan\theta$ (C) $i\cot\frac{\theta}{2}$ (D) $i\tan\frac{\theta}{2}$ (E) $2\tan\theta$

**31.** Three numbers $x$, $y$, and $z$ are in arithmetic progression. If $x+y+z=-3$ and $xyz=8$, then $x^2+y^2+z^2$ is equal to

(A) 9 (B) 10 (C) 21 (D) 20 (E) 1

**32.** The 30th term of the arithmetic progression 10, 7, 4 is

(A) –97 (B) –87 (C) –77 (D) –67 (E) –57

**33.** The arithmetic mean of two numbers $x$ and $y$ is 3 and geometric mean is 1. Then $x^2+y^2$ is equal to

(A) 30 (B) 31 (C) 32 (D) 33 (E) 34

---

Space for rough work

34. The solution of $3^{2x-1} = 81^{1-x}$ is

(A) $\frac{2}{3}$ (B) $\frac{1}{6}$ (C) $\frac{7}{6}$ (D) $\frac{5}{6}$ (E) $\frac{1}{3}$

35. The sixth term in the sequence is 3, 1, $\frac{1}{3}$, ... is

(A) $\frac{1}{27}$ (B) $\frac{1}{9}$ (C) $\frac{1}{81}$ (D) $\frac{1}{17}$ (E) $\frac{1}{7}$

36. Three numbers are in arithmetic progression. Their sum is 21 and the product of the first number and the third number is 45. Then the product of these three numbers is

(A) 315 (B) 90 (C) 180 (D) 270 (E) 450

37. If $a+1$, $2a+1$, $4a-1$ are in arithmetic progression, then the value of $a$ is

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

Space for rough work

**38.** Two numbers $x$ and $y$ have arithmetic mean 9 and geometric mean 4. Then $x$ and $y$ are the roots of

(A) $x^2-18x-16=0$ (B) $x^2-18x+16=0$

(C) $x^2+18x-16=0$ (D) $x^2+18x+16=0$

(E) $x^2-17x+16=0$

**39.** Three unbiased coins are tossed. The probability of getting at least 2 tails is

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

**40.** A single letter is selected from the word TRICKS. The probability that it is either T or R is

(A) $\frac{1}{36}$ (B) $\frac{1}{4}$ (C) $\frac{1}{2}$ (D) $\frac{2}{3}$ (E) $\frac{1}{3}$

**41.** From 4 red balls, 2 white balls and 4 black balls, four balls are selected. The probability of getting 2 red balls is

(A) $\frac{7}{21}$ (B) $\frac{8}{21}$ (C) $\frac{9}{21}$ (D) $\frac{10}{21}$ (E) $\frac{11}{21}$

---

Space for rough work

**42.** In a class, 60% of the students know lesson I, 40% know lesson II and 20% know lesson I and lesson II. A student is selected at random. The probability that the student does not know lesson I and lesson II is

(A) 0 (B) $\frac{4}{5}$ (C) $\frac{3}{5}$ (D) $\frac{1}{5}$ (E) $\frac{2}{5}$

**43.** Two distinct numbers $x$ and $y$ are chosen from 1, 2, 3, 4, 5. The probability that the arithmetic mean of $x$ and $y$ is an integer is

(A) 0 (B) $\frac{1}{5}$ (C) $\frac{3}{5}$ (D) $\frac{2}{5}$ (E) $\frac{4}{5}$

**44.** The number of $3 \times 3$ matrices with entries $-1$ or $+1$ is

(A) $2^4$ (B) $2^5$ (C) $2^6$ (D) $2^7$ (E) $2^9$

**45.** Let S be the set of all $2 \times 2$ symmetric matrices whose entries are either zero or one. A matrix X is chosen from S. The probability that the determinant of X is not zero is

(A) $\frac{1}{3}$ (B) $\frac{1}{2}$ (C) $\frac{3}{4}$ (D) $\frac{1}{4}$ (E) $\frac{2}{9}$

---

Space for rough work

**46.** The number of words that can be formed by using all the letters of the word PROBLEM only once is

(A) 5! (B) 6! (C) 7! (D) 8! (E) 9!

**47.** The number of diagonals in a hexagon is

(A) 8 (B) 9 (C) 10 (D) 11 (E) 12

**48.** The sum of odd integers from 1 to 2001 is

(A) $1001^2$ (B) $1000^2$ (C) $1002^2$ (D) $1003^2$ (E) $999^2$

**49.** Two balls are selected from two black and two red balls. The probability that the two balls will have no black ball is

(A) $\frac{1}{7}$ (B) $\frac{1}{5}$ (C) $\frac{1}{4}$ (D) $\frac{1}{3}$ (E) $\frac{1}{6}$

**50.** If $z=i^9+i^{19}$, then $z$ is equal to

(A) $0+0i$ (B) $1+0i$ (C) $0+i$ (D) $1+2i$ (E) $1+3i$

---

Space for rough work

51. The mean for the data 6, 7, 10, 12, 13, 4, 8, 12 is

(A) 9 (B) 8 (C) 7 (D) 6 (E) 5

52. The set of all real numbers satisfying the inequality $x-2<1$ is

(A) $(3,\infty)$ (B) $[3,\infty)$ (C) $[-3,\infty)$ (D) $(-\infty,-3)$ (E) $(-\infty,3)$

53. If $\frac{|x-3|}{x-3}>0$, then

(A) $x\in(-3,\infty)$ (B) $x\in(3,\infty)$ (C) $x\in(2,\infty)$ (D) $x\in(1,\infty)$ (E) $x\in(-1,\infty)$

54. The mode of the data 8, 11, 9, 8, 11, 9, 7, 8, 7, 3, 2, 8 is

(A) 11 (B) 9 (C) 8 (D) 3 (E) 7

55. If the mean of six numbers is 41, then the sum of these numbers is

(A) 246 (B) 236 (C) 226 (D) 216 (E) 206

56. If $\int_0^x f(t)dt=x^2+e^x\,(x>0)$, then $f(1)$ is equal to

(A) $1+e$ (B) $2+e$ (C) $3+e$ (D) $e$ (E) 0

Space for rough work

57. $\int \frac{x+1}{x^{1/2}} dx =$

(A) $-x^{3/2}+x^{1/2}+c$
(B) $x^{1/2}$
(C) $\frac{2}{3}x^{3/2}+2x^{1/2}+c$
(D) $x^{3/2}+x^{1/2}+c$
(E) $x^{3/2}$

58. In a flight 50 people speak Hindi, 20 speak English and 10 speak both English and Hindi. The number of people who speak at least one of the two languages is

(A) 40 (B) 50 (C) 20 (D) 80 (E) 60

59. If $f(x)=\frac{x+1}{x-1}$, then the value of $f(f(x))$ is equal to

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

60. Two dice are thrown simultaneously. What is the probability of getting two numbers whose product is even ?

(A) $\frac{3}{4}$ (B) $\frac{1}{4}$ (C) $\frac{1}{2}$ (D) $\frac{2}{3}$ (E) $\frac{1}{16}$

---

Space for rough work

61. $\lim_{x \to 0} \frac{\sqrt{2+x}-\sqrt{2-x}}{x}$ is equal to

(A) $\frac{1}{\sqrt{2}}$ (B) $\sqrt{2}$ (C) 0 (D) Does not exist (E) $\frac{1}{2\sqrt{2}}$

62. $\int \frac{dx}{e^x+e^{-x}+2}$ is equal to

(A) $\frac{1}{e^x+1}+c$ (B) $\frac{-1}{e^x+1}+c$ (C) $\frac{1}{1+e^{-x}}+c$ (D) $\frac{1}{e^{-x}-1}+c$ (E) $\frac{1}{e^x-1}+c$

63. $\tan\left(\frac{\pi}{4}+\frac{\theta}{2}\right)+\tan\left(\frac{\pi}{4}-\frac{\theta}{2}\right)$ is equal to

(A) $\sec\theta$ (B) $2\sec\theta$ (C) $\sec\frac{\theta}{2}$ (D) $\sin\theta$ (E) $\cos\theta$

64. $\int_{-1}^{0} \frac{dx}{x^2+x+2}$ is equal to

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

Space for rough work

65. $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\sin x}}{\sqrt{\sin x}+\sqrt{\cos x}}\, dx$ is equal to

(A) 0 (B) $-\pi$ (C) $\frac{3\pi}{2}$ (D) $\frac{\pi}{2}$ (E) $\frac{\pi}{4}$

66. If $(x, y)$ is equidistant from $(a+b, b-a)$ and $(a-b, a+b)$, then

(A) $x+y=0$
(B) $bx-ay=0$
(C) $ax-by=0$
(D) $bx+ay=0$
(E) $ax+by=0$

67. If the points (1, 0), (0, 1) and $(x, 8)$ are collinear, then the value of $x$ is equal to

(A) 5 (B) –6 (C) 6 (D) 7 (E) –7

68. The minimum value of the function $max\{x, x^2\}$ is equal to

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

69. Let $f(x+y)=f(x)f(y)$ for all $x$ and $y$. If $f(0)=1, f(3)=3$ and $f'(0)=11$, then $f'(3)$ is equal to

(A) 11 (B) 22 (C) 33 (D) 44 (E) 55

---

Space for rough work

70. If $f(9)=f'(9)=0$, then $\lim\limits_{x\to 9}\dfrac{\sqrt{f(x)}-3}{\sqrt{x}-3}$ is equal to

(A) 0 (B) $f(0)$ (C) $f'(3)$ (D) $f(9)$ (E) 1

71. The value of $\cos\left(\dfrac{\pi}{4}+x\right)+\cos\left(\dfrac{\pi}{4}-x\right)$ is

(A) $\sqrt{2}\sin^2 x$ (B) $\sqrt{2}\sin x$ (C) $\sqrt{2}\cos^2 x$ (D) $\sqrt{3}\cos x$ (E) $\sqrt{2}\cos x$

72. Area of the triangle with vertices $(-2, 2), (1, 5)$ and $(6, -1)$ is

(A) 15 (B) $\dfrac{3}{5}$ (C) $\dfrac{29}{2}$ (D) $\dfrac{33}{2}$ (E) $\dfrac{35}{2}$

73. The equation of the line passing through (–3, 5) and perpendicular to the line through the points (1, 0) and (–4, 1) is

(A) $5x+y+10=0$ (B) $5x-y+20=0$
(C) $5x-y-10=0$ (D) $5x+y+20=0$
(E) $5y-x-10=0$

74. The coefficient of $x^5$ in the expansion of $(1+x^2)^5(1+x)^4$ is

(A) 30 (B) 60 (C) 40 (D) 10 (E) 45

Space for rough work

75. The coefficient of $x^4$ in the expansion of $(1-2x)^5$ is equal to

(A) 40 (B) 320 (C) –320 (D) –32 (E) 80

76. The equation $5x^2+y^2+y=8$ represents

(A) an ellipse
(B) a parabola
(C) a hyperbola
(D) a circle
(E) a straight line

77. The center of the ellipse $4x^2+y^2-8x+4y-8=0$ is

(A) (0, 2) (B) (2, –1) (C) (2, 1) (D) (1, 2) (E) (1, –2)

78. The area bounded by the curves $y=-x^2+3$ and $y=0$ is

(A) $\sqrt{3}+1$ (B) $\sqrt{3}$ (C) $4\sqrt{3}$ (D) $5\sqrt{3}$ (E) $6\sqrt{3}$

79. The order of the differential equation $\left(\frac{d^3y}{dx^3}\right)^2+\left(\frac{d^2y}{dx}\right)^2+\left(\frac{dy}{dx}\right)^5=0$ is

(A) 3 (B) 4 (C) 1 (D) 5 (E) 6

Space for rough work

**80.** If $f(x)=\sqrt{2x}+\frac{4}{\sqrt{2x}}$, then $f'(2)$ is equal to

(A) 0 (B) −1 (C) 1 (D) 2 (E) −2

**81.** The area of the circle $x^2-2x+y^2-10y+k=0$ is $25\pi$. The value of $k$ is equal to

(A) −1 (B) 1 (C) 0 (D) 2 (E) 3

**82.** $\int_{2016}^{2017}\frac{\sqrt{x}}{\sqrt{x}+\sqrt{4033-x}}dx$ is equal to

(A) $\frac{1}{4}$ (B) $\frac{3}{2}$ (C) $\frac{2017}{2}$ (D) $\frac{1}{2}$ (E) 508

**83.** The solution of $\frac{dy}{dx}+y\tan x=\sec x, y(0)=0$ is

(A) $y\sec x=\tan x$ (B) $y\tan x=\sec x$

(C) $\tan x=y\tan x$ (D) $x\sec x=\tan y$

(E) $y\cot x=\sec x$

**84.** If the vectors $2\hat{i}+2\hat{j}+6\hat{k}$, $2\hat{i}+\lambda\hat{j}+6\hat{k}$, $2\hat{i}-3\hat{j}+\hat{k}$ are coplanar, then the value of $\lambda$ is

(A) −10 (B) 1 (C) 0 (D) 10 (E) 2

Space for rough work

**85.** The distance between (2, 1, 0) and $2x+y+2z+5=0$ is

(A) 10 (B) $\frac{10}{3}$ (C) $\frac{10}{9}$ (D) 5 (E) 1

**86.** The equation of the hyperbola with vertices $(0, \pm 15)$ and foci $(0, \pm 20)$ is

(A) $\frac{x^2}{175}-\frac{y^2}{225}=1$

(B) $\frac{x^2}{625}-\frac{y^2}{125}=1$

(C) $\frac{y^2}{225}-\frac{x^2}{125}=1$

(D) $\frac{y^2}{65}-\frac{x^2}{65}=1$

(E) $\frac{y^2}{225}-\frac{x^2}{175}=1$

**87.** The value of $\frac{15^3+6^3+3.6.15.21}{1+4(6)+6(36)+4(216)+1296}$ is equal to

(A) $\frac{29}{7}$ (B) $\frac{7}{19}$ (C) $\frac{6}{17}$ (D) $\frac{21}{19}$ (E) $\frac{27}{7}$

---

Space for rough work

**88.** The equation of the plane that passes through the points (1, 0, 2), (–1, 1, 2) (5, 0, 3) is

(A) $x+2y-4z+7=0$ (B) $x+2y-3z+7=0$

(C) $x-2y+4z+7=0$ (D) $2y-4z-7+x=0$

(E) $x+2y+3z+7=0$

**89.** The vertex of the parabola $y^2-4y-x+3=0$ is

(A) (–1, 3) (B) (–1, 2) (C) (2, –1) (D) (3, –1) (E) (1, 2)

**90.** If $\vec{a},\vec{b},\vec{c}$ are vectors such that $\vec{a}+\vec{b}+\vec{c}=0$ and $|\vec{a}|=7, |\vec{b}|=5, |\vec{c}|=3$, then the angle between $\vec{c}$ and $\vec{b}$ is

(A) $\frac{\pi}{3}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{4}$ (D) $\pi$ (E) 0

**91.** Let $f(x)=2x^3-9ax^2+12a^2x+1$, where $a > 0$. The minimum of $f$ is attained at a point $q$ and the maximum is attained at a point $p$. If $p^3=q$, then $a$ is equal to

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

Space for rough work

92. For all real numbers $x$ and $y$, it is known that the real valued function $f$ satisfies $f(x)+f(y)=f(x+y)$. If $f(1)=7$, then $\sum_{r=1}^{100} f(r)$ is equal to

(A) $7\times51\times102$
(B) $6\times50\times102$
(C) $7\times50\times102$
(D) $6\times25\times102$
(E) $7\times50\times101$

93. The eccentricity of the ellipse $\frac{(x-1)^2}{2}+\left(y+\frac{3}{4}\right)^2=\frac{1}{16}$ is

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

94. $\int_{-1}^{1} max\{x,x^3\}dx$ is equal to

(A) $\frac{3}{4}$ (B) $\frac{1}{4}$ (C) $\frac{1}{2}$ (D) 1 (E) 0

Space for rough work

95. If $x \in \left[0, \frac{\pi}{2}\right], y \in \left[0, \frac{\pi}{2}\right]$ and $\sin x + \cos y = 2$, then the value of $x + y$ is equal to

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

96. Let $a$, $a + r$ and $a + 2r$ be positive real numbers such that their product is 64. Then the minimum value of $a + 2r$ is equal to

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

97. The sum $S = \frac{1}{9!} + \frac{1}{3!7!} + \frac{1}{5!5!} + \frac{1}{7!3!} + \frac{1}{9!}$ is equal to

(A) $\frac{2^{10}}{8!}$ (B) $\frac{2^9}{10!}$ (C) $\frac{2^7}{10!}$ (D) $\frac{2^6}{10!}$ (E) $\frac{2^5}{8!}$

98. If $f(x) = \begin{vmatrix} x & x^2 & x^3 \\ 1 & 2x & 3x^2 \\ 0 & 2 & 6x \end{vmatrix}$, then $f'(x)$ is equal to

(A) $x^3 + 6x^2$ (B) $6x^3$ (C) $3x$ (D) $6x^2$ (E) 0

---

Space for rough work

99. $\int \frac{x^2}{1+(x^3)^2}\, dx$ is equal to

(A) $\tan^{-1} x^2 + c$

(B) $\frac{2}{3}\tan^{-1} x^3 + c$

(C) $\frac{1}{3}\tan^{-1}(x^3) + c$

(D) $\frac{1}{2}\tan^{-1} x^2 + c$

(E) $\tan^{-1} x^3 + c$

100. Let $f_n(x)$ be the $n^{\text{th}}$ derivative of $f(x)$. The least value of $n$ so that $f_n = f_{n+1}$ where $f(x) = x^2 + e^x$ is

(A) 4 (B) 5 (C) 2 (D) 3 (E) 6

101. sin 765° is equal to

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

Space for rough work

**102.** The distance of the point (3, –5) from the line $3x - 4y - 26 = 0$ is

(A) $\frac{3}{7}$ (B) $\frac{2}{5}$ (C) $\frac{7}{5}$ (D) $\frac{3}{5}$ (E) 1

**103.** The difference between the maximum and minimum value of the function $f(x) = \int_0^x (t^2 + t + 1)dt$ on [2, 3] is

(A) $\frac{39}{6}$ (B) $\frac{49}{6}$ (C) $\frac{59}{6}$ (D) $\frac{69}{6}$ (E) $\frac{79}{6}$

**104.** If $a$ and $b$ are the non zero distinct roots of $x^2 + ax + b = 0$, then the minimum value of $x^2 + ax + b$ is

(A) $\frac{2}{3}$ (B) $\frac{9}{4}$ (C) $\frac{-9}{4}$ (D) $\frac{-2}{3}$ (E) 1

---

Space for rough work

**105.** If the straight line $y=4x+c$ touches the ellipse $\frac{x^2}{4}+y^2=1$ then $c$ is equal to

(A) 0 (B) $\pm\sqrt{65}$ (C) $\pm\sqrt{62}$ (D) $\pm\sqrt{2}$ (E) $\pm 13$

**106.** The equations $\lambda x-y=2$, $2x-3y=-\lambda$ and $3x-2y=-1$ are consistent for

(A) $\lambda=-4$ (B) $\lambda=1, 4$ (C) $\lambda=1, -4$ (D) $\lambda=-1, 4$ (E) $\lambda=-1$

**107.** The set $\{(x,y):|x|+|y|=1\}$ in the $xy$ plane represents

(A) a square
(B) a circle
(C) an ellipse
(D) a rectangle which is not a square
(E) a rhombus which is not a square

---

Space for rough work

**108.** The value of $\cos\left(\tan^{-1}\left(\frac{3}{4}\right)\right)$ is

(A) $\frac{4}{5}$ (B) $\frac{3}{5}$ (C) $\frac{3}{4}$ (D) $\frac{2}{5}$ (E) 0

**109.** Let A(6, –1), B(1, 3) and C($x$, 8) be three points such that AB = BC. The values of $x$ are

(A) 3, 5 (B) –3, 5 (C) 3, –5 (D) 4, 5 (E) –3, –5

**110.** In an experiment with 15 observations on $x$, the following results were available

$\sum x^2 = 2830$
$\sum x = 170$

One observation that was 20, was found to be wrong and was replaced by the correct value 30. Then the corrected variance is

(A) 9.3 (B) 8.3 (C) 188.6 (D) 177.3 (E) 78

**111.** The angle between the pair of lines $\frac{x-2}{2}=\frac{y-1}{5}=\frac{z+3}{-3}$ and $\frac{x+2}{-1}=\frac{y-4}{8}=\frac{z-5}{4}$ is

(A) $\cos^{-1}\left(\frac{21}{9\sqrt{38}}\right)$ (B) $\cos^{-1}\left(\frac{23}{9\sqrt{38}}\right)$

(C) $\cos^{-1}\left(\frac{24}{9\sqrt{38}}\right)$ (D) $\cos^{-1}\left(\frac{25}{9\sqrt{38}}\right)$

(E) $\cos^{-1}\left(\frac{26}{9\sqrt{38}}\right)$

Space for rough work

**112.** Let $\vec{a}$ be a unit vector. If $(\vec{x}-\vec{a}).(\vec{x}+\vec{a})=12$, then the magnitude of $\vec{x}$ is

(A) $\sqrt{8}$ (B) $\sqrt{9}$ (C) $\sqrt{10}$ (D) $\sqrt{13}$ (E) $\sqrt{12}$

**113.** The area of the triangular region whose sides are $y=2x+1, y=3x+1$ and $x=4$ is

(A) 5 (B) 6 (C) 7 (D) 8 (E) 9

**114.** If $nC_{r-1}=36$, $nC_r=84$ and $nC_{r+1}=126$, then the value of $r$ is

(A) 9 (B) 3 (C) 4 (D) 5 (E) 6

**115.** Let $f(x+y)=f(x)f(y)$ and $f(x)=1+\sin(3x)g(x)$, where $g$ is differentiable. Then $f'(x)$ is equal to

(A) $3f(x)$ (B) $g(0)$ (C) $f(x)g(0)$ (D) $3g(x)$ (E) $3f(x)g(0)$

**116.** The roots of the equation $\begin{vmatrix} x-1 & 1 & 1 \\ 1 & x-1 & 1 \\ 1 & 1 & x-1 \end{vmatrix}=0$ are

(A) 1, 2 (B) −1, 2 (C) −1, −2 (D) 1, −2 (E) 1, 1

Space for rough work

**117.** If the $7^{th}$ and $8^{th}$ term of the binomial expansion $(2a-3b)^n$ are equal, then $\frac{2a+3b}{2a-3b}$ is equal to

(A) $\frac{13-n}{n+1}$ (B) $\frac{n+1}{13-n}$ (C) $\frac{6-n}{13-n}$ (D) $\frac{n-1}{13-n}$ (E) $\frac{2n-1}{13-n}$

**118.** Standard deviation of first $n$ odd natural numbers is

(A) $\sqrt{n}$ (B) $\sqrt{\frac{(n+2)(n+1)}{3}}$ (C) $\sqrt{\frac{n^2-1}{3}}$ (D) $n$ (E) $2n$

**119.** Let S = {1, 2, 3,..., 10}. The number of subsets of S containing only odd numbers is

(A) 15 (B) 31 (C) 63 (D) 7 (E) 5

**120.** The area of the parallelogram with vertices (0, 0), (7, 2) (5, 9) and (12, 11) is

(A) 50 (B) 54 (C) 51 (D) 52 (E) 53

---

Space for rough work

SEAL

BLANK PAGE