SEAL

Test Booklet Number	Subject Code - 1204	Roll Number
41051	**MATHEMATICS**	

[Time : 1 Hour] [Maximum Marks : 200]

INSTRUCTIONS TO CANDIDATES

Read the following instructions carefully before you answer the questions given in this Test Booklet :

1. Answers to questions in this Test Booklet are to be given on an **OMR Answer Sheet** provided to the candidate **separately.**
2. Candidate must fill up Name, Category, Test Booklet Number, Subject Code and Roll Number in the Answer Sheet carefully as per instructions given.
3. This Test Booklet consists of 50 questions. All questions are compulsory and carry equal marks.
4. Each question in this Test Booklet has four possible alternative answers namely, (A), (B), (C) and (D), one of which is correct. Candidate should choose the correct answer against each question out of four alternative answers.
5. Candidate is instructed to answer the questions by **darkening (●)** with **Ball Point Pen** only in the circle bearing the correct answer.
6. Candidate should not attempt more than one answer in each question. More than one attempt in any form against a question shall be treated as incorrect.
7. Marking of answer other than darkening shall be cancelled and darkening should remain within the circle or otherwise computer shall not accept during evaluation of answer-script.
8. Rough work must not be done on the Answer Sheet. Use the blank space given in the Test Booklet for rough work.
9. Candidate is to hand over the Answer Sheet to the Invigilator before leaving the Examination Hall.
10. **NEGATIVE MARKING** : Each question carries 4 (four) marks for correct response. For each incorrect response, 1 (one) mark will be deducted from the total score. More than one answer indicated against a question will be deemed as incorrect response and will be negatively marked.

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MATHEMATICS

1. If $3\tan A\tan B = 1$, then the value of $\cos(A+B)$ is

   (A) $\cos(A-B)$

   (B) $\cos\left(\frac{A-B}{2}\right)$

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

   (D) $2\cos(A-B)$

2. If α and β are acute angles such that $\tan\alpha = \frac{m}{m+1}$ and $\tan\beta = \frac{1}{2m+1}$, then $(\alpha+\beta)$ equals

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

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

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

   (D) $\frac{2\pi}{3}$

3. The general solution of the trigonometric equation $2\cos^2\theta + 3\sin\theta = 0$ is

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

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

   (C) $n\pi + (-1)^{n+1}\frac{\pi}{4}$

   (D) $n\pi + (-1)^{n}\frac{\pi}{3}$

4. If $\frac{3+2i\sin2\theta}{1-2i\sin2\theta} = 3$, $0 < \theta < \pi$, then θ equals

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

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

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

   (D) $\frac{\pi}{6}$

5. If $z = \frac{1}{(1-i)(2+3i)}$, then $|z|$ equals

   (A) 1

   (B) $\frac{1}{\sqrt{26}}$

   (C) $\frac{5}{\sqrt{26}}$

   (D) $\frac{7}{\sqrt{26}}$

6. The number of real roots of the equation $(x^2+2x)^2 - (x+1)^2 - 55 = 0$ is

   (A) 2

   (B) 1

   (C) 4

   (D) 3

7. If the difference of the roots of the equation $x^2 - px + q = 0$ is unity, then

(A) $p^2 + 4q = 1$

(B) $p^2 - 4q = 1$

(C) $p^2 + 4q^2 = 1$

(D) $4p^2 - q^2 = 1$

8. The solution set of the inequation $(x^2 - 2x + 1)(x - 4) < 0$ is

(A) $(4, \infty)$

(B) $(-\infty, 4) - \{1\}$

(C) $(-\infty, -4)$

(D) $(-4, \infty) - \{1\}$

9. The sum of n terms of an A.P. is $an(n-1)$. The sum of squares of these terms is

(A) $a^2n^2(n-1)^2$

(B) $\frac{a^2}{6} n(n-1)(2n-1)$

(C) $\frac{2a^2}{3} n(n-1)(2n-1)$

(D) $\frac{2a^2}{3} n(n+1)(2n+1)$

10. The sum of the series $\frac{1}{2} + \frac{1}{3} + \frac{1}{6} + 0 + \ldots$ to 9 terms is

(A) $-\frac{5}{6}$

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

(C) 1

(D) $-\frac{3}{2}$

11. ${}^{100}C_{50} + 2\,{}^{100}C_{49} + {}^{100}C_{48}$, equals

(A) ${}^{101}C_{49}$

(B) $2 \times {}^{101}C_{51}$

(C) $2 \times {}^{102}C_{50}$

(D) ${}^{102}C_{50}$

12. If 7 points out of 12 are in the same straight line and none of the other three are collinear, then the number of triangles formed is

(A) 19

(B) 158

(C) 185

(D) 201

13. The total number of six digit numbers that can be made with digits 1, 2, 3, 4 if all digits are to appear in a number at least once is

(A) 1560

(B) 840

(C) 1080

(D) 480

14. The number of terms in the expansion of $(1 + 5\sqrt{2}\,x)^9 + (1 - 5\sqrt{2}\,x)^9$ in powers of x is

(A) 10

(B) 9

(C) 7

(D) 5

15. L is a variable line such that the algebraic sum of the distances of the points (1, 1), (2, 0) and (0, 2) from the line is equal to zero. The line L will always pass through

(A) (1, 1)

(B) (2, 1)

(C) (1, 2)

(D) (−2, −2)

16. A line passes through the point (2, 2) and is perpendicular to the line $3x + y = 3$. Its y-intercept is

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

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

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

(D) $-\frac{4}{3}$

17. If the circles $x^2 + y^2 = 9$ and $x^2 + y^2 + 8y + c = 0$ touch each other externally, then c is equal to

(A) −33

(B) 16

(C) 15

(D) −15

18. The equation of the ellipse whose axes are along coordinate axes, vertices are $(\pm 5, 0)$ and foci are at $(\pm 4, 0)$ is

(A) $\frac{x^2}{25} + \frac{y^2}{9} = 1$

(B) $\frac{x^2}{9} + \frac{y^2}{25} = 1$

(C) $\frac{x^2}{9} + \frac{y^2}{16} = 1$

(D) $\frac{x^2}{16} + \frac{y^2}{25} = 1$

19. The statement that is not equivalent to p : A natural number is odd implies its square is an odd natural number is

(A) If a natural number is odd, then its square is odd natural number

(B) A natural number is odd only if its square is odd natural number

(C) For a natural number to be odd, it is sufficient that its square is an odd natural number

(D) If the square of a natural number is not odd, then the natural number is not odd

20. The sum of 10 observations is 120 and sum of squares of these observations is 1530, then their variance equals

(A) 3

(B) 9

(C) $\sqrt{12}$

(D) 12

21. If A, B are two sets and U is the universal set such that $n(U) = 700, n(A) = 200, n(B) = 300$ and $n(A \cap B) = 100$, then $n(A' \cap B')$ equals

(A) 500

(B) 400

(C) 300

(D) 200

22. Let the function $f : R - \{-b\} \to R - \{1\}$ be defined as $f(x) = \frac{x}{x+1}$, then

(A) f is one-one but not onto

(B) f is onto but not one-one

(C) f is both one-one and onto

(D) f is neither one-one nor onto

23. If $g(x) = x^2 + x - 2$ and $\frac{1}{2} g \circ f(x) = 2x^2 - 5x + 2$, then $f(x)$ equals

(A) $-2x + 2$

(B) $2x + 3$

(C) $2x^2 + 3x + 1$

(D) $2x^2 - 3x - 1$

24. If $\cos^{-1}\frac{x}{a} + \cos^{-1}\frac{y}{b} = \alpha$, then $\frac{x^2}{a^2} - \frac{2xy}{ab}\cos\alpha + \frac{y^2}{b^2}$ equals

(A) $\sin^2\alpha$

(B) $\cos^2\alpha$

(C) $\tan^2\alpha$

(D) $\cot^2\alpha$

25. If $\tan^{-1}3 + \tan^{-1}x = \tan^{-1}8$, then x equals

(A) 5

(B) $\frac{1}{5}$

(C) $\frac{5}{14}$

(D) $\frac{14}{5}$

26. If $A = \begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is such that $A^2 = I$, then

(A) $1+\alpha^2+\beta\gamma=0$

(B) $1-\alpha^2+\beta\gamma=0$

(C) $1-\alpha^2-\beta\gamma=0$

(D) $1+\alpha^2-\beta\gamma=0$

27. If $A = \begin{bmatrix} 0 & 2 \\ 3 & -4 \end{bmatrix}$, $kA = \begin{bmatrix} 0 & 3a \\ 2b & 24 \end{bmatrix}$, then the values of k, a and b respectively are

(A) $-6, -12, -18$

(B) $-6, 4, 9$

(C) $-6, -4, -9$

(D) $-6, 12, 18$

28. If $a > 0$ and discriminant of the polynomial $ax^2 + 2bx + c$ is negative, then the value of $\begin{vmatrix} a & b & ax+b \\ b & c & bx+c \\ ax+b & bx+c & 0 \end{vmatrix}$ is

(A) Positive

(B) $(ac - b^2)(ax^2 + 2bx + c)$

(C) Negative

(D) A perfect square

29. The value of the determinant $\begin{vmatrix} x+1 & x+2 & x+4 \\ x+3 & x+5 & x+9 \\ x+7 & x+10 & x+16 \end{vmatrix}$ is

(A) -2

(B) 2

(C) $x^2 + 2$

(D) 0

30. Let $f(x) = \begin{cases} \frac{x-4}{|x-4|} + a, & x < 4 \\ a+b, & x = 4 \\ \frac{x-4}{|x-4|} + b, & x > 4 \end{cases}$, then $f(x)$ is continuous at $x = 4$, when

(A) $a = 0, b = 0$

(B) $a = 1, b = 1$

(C) $a = -1, b = 1$

(D) $a = 1, b = -1$

31. If $s = t^3 - 4t^2 + 5$ describes the motion of a particle along a straight line path, then its velocity when the acceleration vanishes is

(A) $\frac{16}{9}$ unit/sec

(B) $-\frac{32}{3}$ unit/sec

(C) $\frac{4}{3}$ unit/sec

(D) $\frac{-16}{3}$ unit/sec

32. The value of c in Rolle's theorem when $f(x) = 2x^3 - 5x^2 - 4x + 3, x \in [-1, 3]$ is

(A) 2 or $\frac{-1}{3}$

(B) $\frac{-1}{3}$ or -2

(C) -2

(D) $\frac{2}{3}$ or -4

33. If the line $y = x$ touches the curve $y = x^2 + bx + c$ at $(1, 1)$, then

(A) $b = 1, c = 2$

(B) $b = -1, c = 1$

(C) $b = 2, c = 1$

(D) $b = -2, c = 1$

34. If the function $f(x) = kx^3 - 9x^2 + 9x + 3$ is monotonically increasing in R, then

(A) $k \leq 1$

(B) $1 < k < 3$

(C) $k > 3$

(D) $k = 3$

35. If $f(x) = a \log x + bx^2 + x$ has extreme values at $x = -1$ and at $x = 2$, then the values of a and b respectively are

(A) $a = -2, b = \frac{1}{2}$

(B) $a = 2, b = -\frac{1}{2}$

(C) $a = \frac{1}{2}, b = -2$

(D) $a = \frac{-1}{2}, b = 2$

36. $\int_{a+3}^{b+3} f(x)\,dx$ is equal to

(A) $\int_a^b f(x-3)\,dx$

(B) $\int_a^b f(x+3)\,dx$

(C) $\int_a^b f(x)\,dx$

(D) $\int_{a-3}^{b-3} f(x)\,dx$

37. $\int_0^{\pi/2} (1 + \log(\tan x))\, dx$ equals

(A) 0

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

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

(D) π

38. The value of $\int_{\frac{-1}{2}}^{\frac{1}{2}} \cos x \log\left(\frac{1+x}{1-x}\right) dx$ is

(A) 0

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

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

(D) -2

39. The value of $\int_2^4 \frac{\sqrt{1-\frac{4}{x^2}}}{x^3}\, dx$ is

(A) $\sqrt{\frac{3}{32}}$

(B) $\frac{\sqrt{3}}{32}$

(C) $\frac{32}{\sqrt{3}}$

(D) $\frac{-\sqrt{3}}{32}$

40. The area of the region bounded by the curve $y = \sqrt{16 - x^2}$ and x-axis is

(A) 8π sq. units

(B) 20π sq. units

(C) 16π sq. units

(D) 256π sq. units

41. The equation of the curve whose slope is given by $\frac{dy}{dx} = \frac{2y}{x}$, $y > 0$ and which passes through (1, 1) is

(A) $x^2 = y$

(B) $y^2 = x$

(C) $x^2 = 2y$

(D) $y^2 = 2x$

42. Unit vectors $\hat{a}$ and $\hat{b}$ are such that $\vec{a} + \vec{b}$ is also a unit vector, then the angle between vectors $\vec{a}$ and $\vec{b}$ is

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

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

(C) $\frac{2\pi}{3}$

(D) $\frac{\pi}{6}$

43. If $\left|\vec{a}\times\vec{b}\right| = 4, \left|\vec{a}\cdot\vec{b}\right| = 2$, then $\left|\vec{a}\right|^2\left|\vec{b}\right|^2$ is equal to

(A) 6

(B) 2

(C) 20

(D) 8

44. If θ is the angle between any two vectors $\vec{a}$ and $\vec{b}$, then $\left|\vec{a}\cdot\vec{b}\right| = \left|\vec{a}\times\vec{b}\right|$ when θ is equal to

(A) 0

(B) $\frac{\pi}{4}$ or $\frac{3\pi}{4}$

(C) $\frac{\pi}{2}$ or $\frac{3\pi}{2}$

(D) $\frac{2\pi}{3}$

45. The angle between the lines $\frac{x-1}{1}=\frac{y-1}{1}=\frac{z-1}{2}$ and $\frac{x-1}{-\sqrt{3}-1}=\frac{y-1}{\sqrt{3}-1}=\frac{z-1}{4}$ is

(A) $\cos^{-1}\left(\frac{1}{65}\right)$

(B) $\frac{\pi}{6}$

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

(D) $\frac{\pi}{4}$

46. The equation of the plane through the intersection of the planes $x + y + z = 0$ and $x - y + z = 1$ and $\perp$ to the plane $x - y - z = 10$ is

(A) $2y - 2z = 1$

(B) $2x + 2y = 1$

(C) $2x + 2z = 1$

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

47. The distance between the planes $2x + 2y - z + 2 = 0$ and $4x + 4y - 2z + 5 = 0$ is

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

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

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

(D) $\frac{1}{12}$

48. If the objective function is given by $z = 2.50x + y$ and the corners of the feasible region are (4, 0), (3, 3), (0, 4) and (2, 3), then the objective function is maximum at

(A) (0, 4)

(B) (4, 0)

(C) (3, 3)

(D) (2, 3)

49. A random variable X takes the values 0, 1, 2, 3 and its mean is 1.3. If $P(X = 3) = 2P(X = 1)$ and $P(X = 2) = 0.3$, then $P(X = 0)$ is

(A) 0.1

(B) 0.2

(C) 0.3

(D) 0.4

50. In a box containing 100 bulbs, 10 bulbs are defective. The probability that out of a random sample of 5 bulbs drawn one by one with replacement, none is defective is

(A) $\left(\frac{9}{10}\right)^5$

(B) $\frac{9}{10}$

(C) 10^{-5}

(D) $\left(\frac{1}{2}\right)^5$