Series MC-XII-SP **Q.P. Code MC/SP/03**

SET ~ 1

Roll No. | | | | | | | |

Candidates must write the Q.P. Code on the title page of the answer-book.

MATHEMATICS

Sample Paper 03 • Class XII • Session 2026–27

(Based on the CBSE Sample Question Paper 2026–27 design and the latest CBSE syllabus)

Time allowed : 3 hours **Maximum Marks : 80**

NOTE

(i) Please check that this question paper contains 6 printed pages.
(ii) Q.P. Code given on the right hand side of the question paper should be written on the title page of the answer-book by the candidate.
(iii) Please check that this question paper contains 38 questions.
(iv) Please write down the serial number of the question in the answer-book before attempting it.
(v) 15 minute time has been allotted to read this question paper. The students will read the question paper only and will not write any answer on the answer-book during this period.

General Instructions :

Read the following instructions very carefully and strictly follow them :

(i) This question paper contains 38 questions. All questions are compulsory.
(ii) This question paper is divided into five Sections – A, B, C, D and E.
(iii) In Section A, Questions no. 1 to 18 are multiple choice questions (MCQs) and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
(iv) In Section B, Questions no. 21 to 25 are Very Short Answer (VSA) type questions, carrying 2 marks each.
(v) In Section C, Questions no. 26 to 31 are Short Answer (SA) type questions, carrying 3 marks each.
(vi) In Section D, Questions no. 32 to 35 are Long Answer (LA) type questions, carrying 5 marks each.
(vii) In Section E, Questions no. 36 to 38 are Case Study based questions, carrying 4 marks each.
(viii) There is no overall choice. However, an internal choice has been provided in 2 questions in Section B, 3 questions in Section C, 2 questions in Section D and one subpart each in 2 questions of Section E.
(ix) Use of calculators is not allowed.

SECTION A

This section comprises 20 multiple choice questions (MCQs) of 1 mark each.

1. The principal value of $\sin^{-1}\left(\cos\frac{\pi}{9}\right)$ is: **1**

(A) $\frac{\pi}{9}$ (B) $\frac{7\pi}{18}$ (C) $\frac{11\pi}{18}$ (D) $-\frac{7\pi}{18}$

2. The principal value branch of $\text{cosec}^{-1}x$ is: **1**

(A) $\left(-\frac{\pi}{2},\frac{\pi}{2}\right)$ (B) $(0, \pi)$

(C) $[0, \pi] - \{\frac{\pi}{2}\}$ (D) $\left[-\frac{\pi}{2},\frac{\pi}{2}\right] - \{0\}$

3. The value of $\cot\left(\sin^{-1}\frac{3}{5}\right)$ is: **1**

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

4. If $A = \begin{bmatrix} 0 & 2 \\ 3 & -4 \end{bmatrix}$ and $kA = \begin{bmatrix} 0 & 3a \\ 2b & 24 \end{bmatrix}$, then the values of k, a and b are respectively: **1**

(A) −6, −12, −18 (B) −6, 4, 9

(C) −6, −4, −9 (D) −6, 12, 18

5. If A is a square matrix of order 3 and |A| = 3, then |2A| is equal to: **1**

(A) 6 (B) 24 (C) 12 (D) 54

6. The matrix $\begin{bmatrix} 0 & -5 & 8 \\ 5 & 0 & 12 \\ -8 & -12 & 0 \end{bmatrix}$ is a: **1**

(A) diagonal matrix (B) symmetric matrix

(C) scalar matrix (D) skew-symmetric matrix

7. The function f(x) = |x| + |x − 1| is: **1**

(A) continuous at x = 0 but not at x = 1

(B) differentiable everywhere

(C) continuous everywhere, but not differentiable at x = 0 and x = 1

(D) not continuous at x = 0 and x = 1

8. If $y = \sin^{-1}x$, then $(1 - x^2)\frac{d^2y}{dx^2}$ is equal to: **1**

(A) $x\frac{dy}{dx}$ (B) $-x\frac{dy}{dx}$ (C) y (D) 0

9. The rate of change of the volume of a sphere with respect to its surface area, when the radius is 2 cm, is: **1**

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

10. The function $f(x) = x^3 - 3x^2 + 3x - 100$ is: **1**

(A) decreasing on (0, ∞) (B) decreasing on R

(C) increasing on R (D) neither increasing nor decreasing

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

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

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12. $\int (e^{\wedge}(x \log a) + e^{\wedge}(a \log x))\, dx$ $(a > 0, a \neq 1)$ is equal to: **1**

(A) $a^x \log a + x^a + C$

(B) $\frac{a^x}{\log a} + \frac{x^{a+1}}{a+1} + C$

(C) $\frac{a^{x+1}}{a+1} + \frac{x^a}{\log a} + C$

(D) $a^x + x^a + C$

13. The vector in the direction of $\vec{a} = \hat{i} - 2\hat{j}$ that has magnitude 7 units is: **1**

(A) $\frac{1}{\sqrt{5}}(\hat{i} - 2\hat{j})$

(B) $7(\hat{i} - 2\hat{j})$

(C) $\frac{\sqrt{5}}{7}(\hat{i} - 2\hat{j})$

(D) $\frac{7}{\sqrt{5}}(\hat{i} - 2\hat{j})$

14. If $\vec{a} \cdot \vec{b} = 0$ and $\vec{a} \times \vec{b} = \vec{0}$, then: **1**

(A) $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$

(B) $\vec{a} \parallel \vec{b}$

(C) $\vec{a} \perp \vec{b}$

(D) $|\vec{a}| = |\vec{b}|$

15. The angle between the vectors $\hat{i} - \hat{j}$ and $\hat{j} - \hat{k}$ is: **1**

(A) $\frac{\pi}{3}$ (B) $\frac{2\pi}{3}$ (C) $-\frac{\pi}{3}$ (D) $\frac{5\pi}{6}$

16. If $P(A) = \frac{7}{13}$, $P(B) = \frac{9}{13}$ and $P(A \cap B) = \frac{4}{13}$, then $P(A' \mid B)$ is: **1**

(A) $\frac{6}{13}$ (B) $\frac{4}{9}$ (C) $\frac{5}{9}$ (D) $\frac{9}{13}$

17. A bag contains 5 red and 3 black balls. Two balls are drawn at random one after the other without replacement. The probability that both balls are red is: **1**

(A) $\frac{25}{64}$ (B) $\frac{5}{14}$ (C) $\frac{5}{8}$ (D) $\frac{10}{28}$

18. A random variable X takes the values 0, 1 and 2 with $P(X = 0) = k$, $P(X = 1) = 2k$ and $P(X = 2) = 3k$. The mean of X is: **1**

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

Questions number 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).

(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).

(C) Assertion (A) is true, but Reason (R) is false.

(D) Assertion (A) is false, but Reason (R) is true.

19. **1**

Assertion (A): $\int e^x \left(\frac{1}{x} - \frac{1}{x^2}\right) dx = \frac{e^x}{x} + C$.

Reason (R): $\int e^x [f(x) + f'(x)]\, dx = e^x f(x) + C$.

20. Assertion (A): The number of arbitrary constants in the general solution of a differential equation of order 3 is 3. **1**

Reason (R): The number of arbitrary constants in the general solution of a differential equation is equal to its order.

SECTION B

This section comprises 5 very short answer (VSA) type questions of 2 marks each.

21. Evaluate $\int_0^{\frac{\pi}{4}} \tan^2 x\, dx$. **2**

OR

Find $\int \frac{dx}{x^2 - 6x + 13}$.

22. If $e^y(x + 1) = 1$, show that $\frac{d^2y}{dx^2} = \left(\frac{dy}{dx}\right)^2$. **2**

23. (A) Find the direction cosines of the line $(x - 2)/2 = (2y - 5)/(-3) = z + 1$. **2**

OR

(B) If $|\vec{a}| = 2$, $|\vec{b}| = 3$ and $\vec{a} \cdot \vec{b} = 4$, find $|\vec{a} - \vec{b}|$.

24. Find the area of the parallelogram whose adjacent sides are given by the vectors $\vec{a} = 3\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$. **2**

25. Determine the maximum value of $Z = 11x + 7y$ subject to the constraints $x \le 3$, $y \le 2$, $x \ge 0$, $y \ge 0$. **2**

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SECTION C

This section comprises 6 short answer (SA) type questions of 3 marks each.

26. Express the matrix $A = \begin{bmatrix} 3 & -2 & -4 \\ 3 & -2 & -5 \\ -1 & 1 & 2 \end{bmatrix}$ as the sum of a symmetric matrix and a skew-symmetric matrix. **3**

27. Find the absolute maximum and absolute minimum values of $f(x) = 2x^3 - 15x^2 + 36x + 1$ on the interval [1, 5]. **3**

28. Find the values of k for which the function $f(x) = \frac{1 - \cos kx}{x \sin x}$, $x \ne 0$, and $f(0) = \frac{1}{2}$ is continuous at $x = 0$. **3**

OR

If $x = a \sec \theta$ and $y = b \tan \theta$, find $\frac{d^2y}{dx^2}$ at $\theta = \frac{\pi}{6}$.

29. Find the general solution of the differential equation $\frac{dy}{dx} - y = \cos x$. **3**

OR

Find the particular solution of the differential equation $(1 + e^{2x})\, dy + (1 + y^2)\, e^x\, dx = 0$, given that $y = 1$ when $x = 0$.

30. Find the coordinates of the foot of the perpendicular drawn from the point P(1, 2, −3) to the line $(x + 1)/2 = (y - 3)/(-2) = z/(-1)$. Also find the length of the perpendicular. **3**

OR

Find the shortest distance between the lines $\vec{r} = (\hat{i} + \hat{j}) + \lambda(2\hat{i} - \hat{j} + \hat{k})$ and $\vec{r} = (2\hat{i} + \hat{j} - \hat{k}) + \mu(4\hat{i} - 2\hat{j} + 2\hat{k})$.

31. Solve the following linear programming problem graphically: Maximise $Z = 4x + y$ subject to $x + y \leq 50$, $3x + y \leq 90$, $x \geq 0$, $y \geq 0$. **3**

SECTION D

This section comprises 4 long answer (LA) type questions of 5 marks each.

32. Show that the relation R defined in the set A of all triangles as $R = \{(T_1, T_2) : T_1 \text{ is similar to } T_2\}$ is an equivalence relation. Consider three right-angled triangles T_1 with sides 3, 4, 5; T_2 with sides 5, 12, 13 and T_3 with sides 6, 8, 10. Which triangles among T_1, T_2 and T_3 are related? **5**

OR

Let $f : N \to N$ be defined by $f(n) = n + 1$ if n is odd and $f(n) = n - 1$ if n is even. Show that f is a bijective function.

33. Evaluate $\int_0^{\frac{\pi}{2}} \frac{x \sin x \cos x}{\sin^4 x + \cos^4 x}\, dx$. **5**

34. Using integration, find the area of the region bounded by the parabola $y^2 = 16x$ and its latus rectum. **5**

OR

Using integration, find the area of the region bounded by the curve $y = \cos x$, the x-axis and the lines $x = 0$ and $x = \pi$.

35. A bank offers loans to its customers at a fixed rate, a floating rate or a variable rate of interest. From past data, a customer takes a loan at a fixed, floating or variable rate with probabilities 10%, 20% and 70% respectively. The probabilities that a customer defaults on loan repayment after taking the loan at a fixed, floating or variable rate are 5%, 3% and 1% respectively.

(a) Find the probability that a customer, after taking a loan, will default on the loan repayment. **2**

(b) A customer, after taking a loan, defaults on the repayment. Find the probability that he had taken the loan at a variable rate of interest. **2**

(c) Find the probability that such a defaulter had taken the loan at a fixed rate. **1**

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SECTION E

This section comprises 3 case study based questions of 4 marks each.

36. A cricket match is organised between two clubs P and Q for which a team from each club is chosen. The remaining players of club P and club Q are respectively sitting along the lines AB and CD, where the points are A(3, 4, 0), B(5, 3, 3), C(6, −4, 1) and D(13, −5, −4).

Based on the above information, answer the following questions:

(i) Write the direction ratios of the vector $\overrightarrow{AB}$. **1**

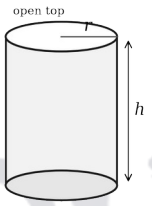
(ii) Write a unit vector in the direction of $\overrightarrow{CD}$. **1**

(iii) (a) Find the angle between the vectors $\overrightarrow{AB}$ and $\overrightarrow{CD}$. **2**

OR

(iii) (b) Write a vector perpendicular to both $\overrightarrow{AB}$ and $\overrightarrow{CD}$. **2**

37. Engine displacement is the measure of the cylinder volume swept by all the pistons of a piston engine. The piston moves inside the cylinder bore. A cylinder bore in the form of a circular cylinder, open at the top, is to be made from a metal sheet of area 75π cm².



Based on the above information, answer the following questions:

(i) If the radius of the cylinder is r cm and its height is h cm, write the volume V of the cylinder in terms of r. **1**

(ii) Find dV/dr. **1**

(iii) (a) Find the radius of the cylinder when its volume is maximum. **2**

OR

(iii) (b) For maximum volume, h > r. State true or false and justify. **2**

38. A factory produces three products daily. The total production on a certain day is 45 tonnes. The production of the third product exceeds that of the first product by 8 tonnes, and the total production of the first and third products is twice the production of the second product. Let the production of the three products be x, y and z tonnes respectively.

Based on the above information, answer the following questions:

(i) Write the given information as a matrix equation AX = B and find |A|. **2**

(ii) Given that adj $A = \begin{bmatrix} 2 & -3 & 1 \\ 2 & 0 & -2 \\ 2 & 3 & 1 \end{bmatrix}$, find the production of each product. **2**

• • • End of Question Paper • • •

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