Series MC-XII-SP **Q.P. Code MC/SP/04**

SET ~ 1

Roll No. | | | | | | | |

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

MATHEMATICS

Sample Paper 04 • 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 $\cot^{-1}\left(-\frac{1}{\sqrt{3}}\right)$ is: **1**

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

2. If $\sin^{-1}x = y$, then: **1**

(A) $-\frac{\pi}{2} \le y \le \frac{\pi}{2}$ (B) $0 \le y \le \pi$

(C) $0 < y < \pi$ (D) $-\frac{\pi}{2} < y < \frac{\pi}{2}$

3. The value of $\tan^{-1}\sqrt{3} - \cot^{-1}(-\sqrt{3})$ is: **1**

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

4. If A is a matrix of order m × n and B is a matrix such that AB′ and B′A are both defined, then the order of matrix B is: **1**

(A) m × m (B) n × n (C) m × n (D) n × m

5. If $A = \begin{bmatrix} 2 & \lambda & -3 \\ 0 & 2 & 5 \\ 1 & 1 & 3 \end{bmatrix}$, then A^{-1} exists if: **1**

(A) $\lambda \neq -\frac{8}{5}$ (B) $\lambda \neq 2$

(C) $\lambda = 2$ (D) $\lambda = -\frac{8}{5}$

6. If $A = \begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is such that $A^2 = I$, then: **1**

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

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

7. If the function $f(x) = \frac{\sin 5x}{3x}$, $x \neq 0$, and $f(0) = k$ is continuous at $x = 0$, then k is equal to: **1**

(A) $\frac{3}{5}$ (B) 15 (C) 5 (D) $\frac{5}{3}$

8. If $y = \log(\cos e^x)$, then $\frac{dy}{dx}$ is equal to: **1**

(A) $-\tan e^x$ (B) $e^x \tan e^x$

(C) $-e^x \tan e^x$ (D) $e^x \cot e^x$

9. The local minimum value of the function $f(x) = x + \frac{1}{x}$, $x > 0$, is: **1**

(A) 1 (B) −2 (C) 2 (D) $\frac{1}{2}$

10. The total revenue (in ₹) received from the sale of x units of a product is $R(x) = 3x^2 + 36x + 5$. The marginal revenue when $x = 5$ is: **1**

(A) ₹30 (B) ₹116 (C) ₹96 (D) ₹66

11. The differential equation having $y = C_1e^x + C_2e^{-x}$ (C_1, C_2 arbitrary constants) as its general solution is: **1**

(A) $\frac{d^2y}{dx^2} - y = 0$ (B) $\frac{d^2y}{dx^2} + y = 0$

(C) $\frac{dy}{dx} - y = 0$ (D) $\frac{d^2y}{dx^2} - \frac{dy}{dx} = 0$

12. $\int \frac{10x^9 + 10^x \log 10}{x^{10} + 10^x}$ dx is equal to: **1**

(A) $10^x - x^{10} + C$ (B) $\log(10^x + x^{10}) + C$

(C) $(10^x - x^{10})^{-1} + C$ (D) $10^x + x^{10} + C$

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13. The unit vector in the direction of the vector PQ, where P and Q are the points (1, 2, 3) and (4, 5, 6) respectively, is: **1**

(A) $\frac{1}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$ (B) $3(\hat{i} + \hat{j} + \hat{k})$

(C) $\frac{1}{3}(\hat{i} + \hat{j} + \hat{k})$ (D) $\hat{i} + \hat{j} + \hat{k}$

14. If θ is the angle between two non-zero vectors $\vec{a}$ and $\vec{b}$, then $\vec{a} \cdot \vec{b} \geq 0$ only when: **1**

(A) $0 < \theta < \frac{\pi}{2}$ (B) $0 \leq \theta \leq \pi$

(C) $0 < \theta < \pi$ (D) $0 \leq \theta \leq \frac{\pi}{2}$

15. The vector with initial point P(2, −3, 5) and terminal point Q(3, −4, 7) is: **1**

(A) $5\hat{i} - 7\hat{j} + 12\hat{k}$ (B) $\hat{i} - \hat{j} + 2\hat{k}$

(C) $-\hat{i} + \hat{j} - 2\hat{k}$ (D) none of these

16. If $P(A) = \frac{1}{2}$ and P(B) = 0, then P(A|B) is: **1**

(A) 0 (B) $\frac{1}{2}$ (C) not defined (D) 1

17. A pair of dice is rolled. The probability of obtaining an even prime number on each die is: **1**

(A) $\frac{1}{36}$ (B) $\frac{1}{3}$ (C) $\frac{1}{12}$ (D) 0

18. A fair coin is tossed twice. If X denotes the number of heads obtained, then the mean of X is: **1**

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

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): $\int_2^8 \frac{\sqrt{10-x}}{\sqrt{x}+\sqrt{10-x}}\,dx = 3$.

Reason (R): $\int_a^b f(x)\,dx = \int_a^b f(a+b-x)\,dx$.

20. **1**

Assertion (A): The integrating factor of the differential equation $\frac{dy}{dx} + \frac{y}{x} = x^2$ (x > 0) is x.

Reason (R): The integrating factor of the linear differential equation $\frac{dy}{dx}$ + Py = Q is e^(∫P dx).

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SECTION B

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

21. Find $\int \frac{dx}{\sqrt{5-4x-x^2}}$. **2**

OR

Evaluate $\int_0^1 \frac{x}{x^2+1}dx$.

22. Differentiate $\sin^2 x$ with respect to e^(cos x). **2**

23. (A) Show that the lines (x − 5)/7 = (y + 2)/(−5) = z/1 and x/1 = y/2 = z/3 are perpendicular to each other. **2**

OR

(B) If $\vec{a} = 5\hat{i} - \hat{j} - 3\hat{k}$ and $\vec{b} = \hat{i} + 3\hat{j} - 5\hat{k}$, show that the vectors $\vec{a} + \vec{b}$ and $\vec{a} - \vec{b}$ are perpendicular.

24. If $\vec{a}$ and $\vec{b}$ are unit vectors inclined at an angle θ, prove that $\sin\frac{\theta}{2} = \frac{1}{2}|\vec{a} - \vec{b}|$. **2**

25. The corner points of the feasible region determined by the constraints of an LPP are (0, 0), (5, 0), (6, 5), (6, 8), (4, 10) and (0, 8). Find the maximum and minimum values of Z = 3x − 4y. **2**

SECTION C

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

26. If $A = \begin{bmatrix} 2 & 3 \\ 1 & -4 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & -2 \\ -1 & 3 \end{bmatrix}$, verify that $(AB)^{-1} = B^{-1}A^{-1}$. **3**

27. Find the intervals in which the function $f(x) = (x+1)^3(x-3)^3$ is strictly increasing or strictly decreasing. **3**

28. If $(x-a)^2 + (y-b)^2 = c^2$, for some $c > 0$, prove that $\frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{(3/2)}}{\frac{d^2y}{dx^2}}$ is a constant independent of a and b. **3**

OR

If $x\sqrt{1+y} + y\sqrt{1+x} = 0$, $-1 < x < 1$, $x \neq y$, prove that $\frac{dy}{dx} = -\frac{1}{(1+x)^2}$.

29. Find the general solution of the differential equation $\frac{dy}{dx} + 3y = e^{-2x}$. **3**

OR

Find the particular solution of the differential equation $\frac{dy}{dx} = \frac{y}{x} - \tan\left(\frac{y}{x}\right)$, given that $y = \frac{\pi}{4}$ when x = 1.

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30. Find the coordinates of the points on the line $(x + 2)/3 = (y + 1)/2 = (z - 3)/2$ which are at a distance of 5 units from the point P(1, 3, 3). **3**

OR

Find the value of p so that the lines $(1 - x)/3 = (7y - 14)/(2p) = (z - 3)/2$ and $(7 - 7x)/(3p) = (y - 5)/1 = (6 - z)/5$ are at right angles.

31. Solve the following linear programming problem graphically: Minimise $Z = 3x + 5y$ subject to $x + 3y \geq 3$, $x + y \geq 2$, $x \geq 0$, $y \geq 0$. **3**

SECTION D

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

32. Show that the relation R in the set of all points in a plane, given by R = {(P, Q) : distance of the point P from the origin is the same as the distance of the point Q from the origin}, is an equivalence relation. Further, show that the set of all points related to a point $P \neq (0, 0)$ is the circle passing through P with the origin as centre. **5**

OR

Show that the function $f : R \to R$ defined by $f(x) = x|x|$ is a bijective function.

33. Find $\int \frac{x^2+x+1}{(x+1)^2(x+2)}\,dx$. **5**

34. Using integration, find the area of the region bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$. **5**

OR

Using integration, find the area of the region bounded by the curve $y = x^3$, the x-axis and the ordinates $x = -2$ and $x = 1$.

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35. A company manufactures smartphones in three factories A, B and C, which produce 50%, 30% and 20% of the total output respectively. Of the smartphones produced, 2%, 3% and 4% respectively are found to be defective. A smartphone is chosen at random from the total output.

(a) Find the probability that the chosen smartphone is defective. **2**

(b) If the chosen smartphone is found to be defective, find the probability that it was produced in factory A. **2**

(c) If the chosen smartphone is found to be defective, find the probability that it was produced in factory B. **1**

SECTION E

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

36. Two tunnels are being dug through a hill for a new highway project. With respect to a fixed origin, the centre-lines of the two tunnels are along the lines $L_1 : \vec{r} = (\hat{i} + \hat{j}) + \lambda(2\hat{i} - \hat{j} + \hat{k})$ and $L_2 : \vec{r} = (2\hat{i} + \hat{j} - \hat{k}) + \mu(3\hat{i} - 5\hat{j} + 2\hat{k})$. For safety, the engineers need to know how close the two tunnels come to each other.

Based on the above information, answer the following questions:

(i) Are the two tunnels parallel? Justify. **1**

(ii) Find a vector perpendicular to both the tunnels. **1**

(iii) (a) Find the shortest distance between the two tunnels. **2**

OR

(iii) (b) Find the angle between the two tunnels. **2**

37. A company manufactures scientific calculators. Market research shows that the price p (in ₹) per calculator at which x calculators can be sold per week is given by the demand function $p = 450 - \frac{x}{2}$. The weekly cost of producing x calculators is C(x) = 50x + 10000 (in ₹).

Based on the above information, answer the following questions:

(i) Write the weekly revenue function R(x). **1**

(ii) Find the marginal revenue when 100 calculators are sold per week. **1**

(iii) (a) Find the number of calculators that should be sold per week to maximise the profit, and the maximum profit. **2**

OR

(iii) (b) Find the interval in which the revenue function is increasing. **2**

38. A grocer sells three varieties of rice P, Q and R. A customer buys 1 kg of P, 2 kg of Q and 3 kg of R for ₹320. Another customer buys 2 kg of P, 1 kg of Q and 2 kg of R for ₹250, and a third buys 3 kg of P, 2 kg of Q and 1 kg of R for ₹280. Let the prices per kg of P, Q and R be ₹x, ₹y and ₹z 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 $A = \begin{bmatrix} -3 & 4 & 1 \\ 4 & -8 & 4 \\ 1 & 4 & -3 \end{bmatrix}$, find the price per kg of each variety of rice. **2**

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