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Your JEE Guide

CBSE Class XII · Mathematics (041)

Sample Question Paper 4 · Session 2026-27

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

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This is an original practice paper written to the official CBSE 2026-27 design; it is not issued by CBSE.

General instructions:

1. This question paper contains 38 questions. All questions are compulsory.
2. This question paper is divided into five Sections: A, B, C, D and E.
3. In Section A, Questions 1 to 18 are multiple choice questions (MCQs) and Questions 19 and 20 are Assertion–Reason based questions of 1 mark each.
4. In Section B, Questions 21 to 25 are very short answer (VSA) type questions carrying 2 marks each.
5. In Section C, Questions 26 to 31 are short answer (SA) type questions carrying 3 marks each.
6. In Section D, Questions 32 to 35 are long answer (LA) type questions carrying 5 marks each.
7. In Section E, Questions 36 to 38 are case study based questions carrying 4 marks each.
8. 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 sub-part each in 2 questions of Section E.
9. Draw neat and clean figures wherever required. Take π = 22/7 wherever required, if not stated.
10. Use of calculators is not allowed.

Section A

1.	The relation R = {(x, y): x + 2y = 8} is defined on the set of natural numbers. The range of R is: (A) {2, 4, 6} (B) {1, 2, 3} (C) {6, 4, 2} (D) {1, 2, 3, 4}	1
2.	Which of the following functions from R to R is onto? (A) $f(x) = \|x\|$ (B) $f(x) = x^2$ (C) $f(x) = e^x$ (D) $f(x) = x^3$	1
3.	The value of $\sin^{-1}\left(\sin\frac{2\pi}{3}\right)$ is: (A) $-\frac{\pi}{3}$ (B) $\frac{2\pi}{3}$ (C) $\frac{\pi}{3}$ (D) $\frac{\pi}{6}$	1
4.	If $\tan^{-1} x = \frac{\pi}{10}$ for some real x, then $\cot^{-1} x$ is: (A) $\frac{2\pi}{5}$ (B) $\frac{3\pi}{5}$ (C) $\frac{4\pi}{5}$ (D) $\frac{\pi}{5}$	1

5.	If $A = \begin{bmatrix} \alpha & \beta \\ \gamma & -\alpha \end{bmatrix}$ is such that $A^2 = I$, then: (A) $\alpha^2 - \beta\gamma = 1$ (B) $\alpha^2 - \beta\gamma = 0$ (C) $\alpha^2 + \beta\gamma = 0$ (D) $\alpha^2 + \beta\gamma = 1$	1
6.	If A is a square matrix of order 2 with |A| = 3, then |A (adj A)| is: (A) 27 (B) 3 (C) 9 (D) 6	1
7.	The value of x for which $\begin{bmatrix} 2 & x \\ 3 & 6 \end{bmatrix}$ is singular is: (A) 6 (B) 4 (C) 2 (D) 3	1
8.	The greatest integer function f(x) = [x] is discontinuous at: (A) every integer (B) no point (C) x = 0 only (D) every real number	1
9.	If $y = e^{3\log x}$, then $\frac{dy}{dx}$ is: (A) $3x^2$ (B) $3x$ (C) e^3 (D) x^3	1
10.	The function $f(x) = 2x^3 - 3x^2 - 12x + 4$ has a local minimum at: (A) x = –1 (B) x = 0 (C) x = 1 (D) x = 2	1
11.	$\int \frac{\sec^2 x}{1 + \tan x}\, dx$ equals: (A) $\log\lvert\sec x\rvert + C$ (B) $\log\lvert 1 + \tan x\rvert + C$ (C) $\tan x + C$ (D) $\frac{1}{1+\tan x} + C$	1
12.	$\int_0^1 xe^x\, dx$ equals: (A) 0 (B) e – 1 (C) 1 (D) e	1
13.	The order of the differential equation $y''' + 2y'' + y' = 0$ is: (A) 2 (B) not defined (C) 1 (D) 3	1
14.	The differential equation whose general solution is y = A sin x + B cos x is: (A) $y'' = 0$ (B) $y'' + y = 0$ (C) $y' + y = 0$ (D) $y'' - y = 0$	1

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15.	The unit vector in the direction of $\vec{a} = 2\hat{i} + 3\hat{j} + \hat{k}$ is: (A) $\frac{1}{6}(2\hat{i} + 3\hat{j} + \hat{k})$ (B) $\frac{1}{14}(2\hat{i} + 3\hat{j} + \hat{k})$ (C) $\frac{1}{\sqrt{14}}(2\hat{i} + 3\hat{j} + \hat{k})$ (D) $2\hat{i} + 3\hat{j} + \hat{k}$	1
16.	If $\vec{a} \cdot \vec{b} = 0$ and $\vec{a} \times \vec{b} = \vec{0}$, then: (A) $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$ (B) $\vec{a}$ and $\vec{b}$ are parallel (C) $\vec{a} = \vec{b}$ (D) $\vec{a}$ and $\vec{b}$ are perpendicular	1
17.	If P(E) = 0.6, P(F) = 0.3 and P(E ∪ F) = 0.7, then P(E|F) is: (A) $\frac{2}{3}$ (B) $\frac{1}{2}$ (C) $\frac{1}{3}$ (D) $\frac{3}{7}$	1
18.	The feasible region of a linear programming problem is: (A) always a triangle (B) the region where the objective function is zero (C) the common region satisfying all the constraints, including non-negativity (D) the region satisfying any one constraint	1
19.	**Assertion (A):** $\lvert\vec{a} \times \vec{b}\rvert^2 + (\vec{a} \cdot \vec{b})^2 = \lvert\vec{a}\rvert^2\lvert\vec{b}\rvert^2$. **Reason (R):** $\sin^2\theta + \cos^2\theta = 1$. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. (B) Both A and R are true but R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1
20.	**Assertion (A):** The matrix $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$ is skew-symmetric. **Reason (R):** All the diagonal elements of a skew-symmetric matrix are zero. (A) Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. (B) Both A and R are true but R is not the correct explanation of A. (C) A is true but R is false. (D) A is false but R is true.	1

Section B

21.	Find the value of $\tan^{-1}\sqrt{3} - \cot^{-1}(-\sqrt{3})$. **OR** If $\sin\left(\sin^{-1}\frac{1}{5} + \cos^{-1}x\right) = 1$, find x.	2
22.	Find k if $f(x) = \begin{cases} \frac{1-\cos 4x}{8x^2}, & x \neq 0 \\ k, & x = 0 \end{cases}$ is continuous at x = 0.	2

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23.	Show that $f(x) = x^3 - 3x^2 + 4x$ is increasing on R. **OR** The volume of a cube is increasing at 8 cm³/s. How fast is its surface area increasing when an edge is 12 cm long?	2
24.	Show that the points A(1, 2, 7), B(2, 6, 3) and C(3, 10, −1) are collinear.	2
25.	P(A) = ½, P(A ∪ B) = 3/5 and P(B) = p. Find p if A and B are independent.	2

Section C

26.	Find $\int \frac{x}{(x^2+1)(x-1)}\,dx$. **OR** Find $\int e^x \frac{1+\sin x}{1+\cos x}\,dx$.	3
27.	Evaluate $\int_2^8 \lvert x-5\rvert\,dx$.	3
28.	Solve $x\frac{dy}{dx} + 2y = x^2 \log x$. **OR** Solve $\frac{dy}{dx} = \frac{x+y}{x}$.	3
29.	Find the angle between the vectors $\vec{a} = \hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$. **OR** Find the area of the triangle with vertices A(1, 1, 2), B(2, 3, 5) and C(1, 5, 5).	3
30.	Solve graphically: minimise Z = −3x + 4y subject to x + 2y ≤ 8, 3x + 2y ≤ 12, x ≥ 0, y ≥ 0.	3
31.	Ten cards numbered 1 to 10 are put in a box, mixed up and one card is drawn. If the number on the card is more than 3, what is the probability that it is an even number?	3

Section D

32.	Show that $f : R \to R$, $f(x) = \frac{x}{x^2+1}$, is neither one-one nor onto. **OR** Show that R = {(a, b): 2 divides a − b} is an equivalence relation on Z. Write the equivalence class [0].	5
33.	The sum of three numbers is 6. If the third number is multiplied by 3 and the second number added, the result is 11. Adding the first and third numbers gives twice the second. Find the numbers using matrices.	5

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34.	Using integration, find the area of the region bounded by the curves $y = x^2$ and $y = \|x\|$. **OR** Using integration, find the area of the region bounded by $y^2 = x$, the lines x = 1 and x = 4, and the x-axis in the first quadrant.	5
35.	Evaluate $\int_0^{\pi/2} \log \sin x \, dx$.	5

Section E

36.	**Case study 1.** The total revenue (in ₹) from the sale of x units of a product is $R(x) = 3x^2 + 36x + 5$. The marginal revenue is the rate of change of total revenue with respect to the number of units sold. (i) Find the marginal revenue function. *[1]* (ii) Find the marginal revenue when x = 5. *[1]* (iii) At what level of sales is the marginal revenue ₹96? *[2]* **OR** (iii) Show that the total revenue increases as more units are sold (x ≥ 0). *[2]*	4
37.	**Case study 2.** A blood test detects a disease correctly in 99% of people who have it, but it also gives a "positive" result for 0.5% of healthy people. 0.1% of the population has the disease. A person is tested at random. (i) Find the probability that the person has the disease and tests positive. *[1]* (ii) Find the probability that the test result is positive. *[1]* (iii) Given a positive result, find the probability that the person actually has the disease. *[2]* **OR** (iii) Given a positive result, find the probability that the person does not have the disease. *[2]*	4
38.	**Case study 3.** A bird flies along the straight line $\vec{r} = (\hat{i} + 2\hat{j} + 3\hat{k}) + \lambda(2\hat{i} + \hat{j} - \hat{k})$, with the origin O at its nest. (i) Find the position of the bird when λ = 2, and its distance from the nest then. *[2]* (ii) Find the point on the line nearest to the nest. *[2]*	4

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Answers and Marking Scheme

Marks for each step are shown in brackets. Any correct alternative method gets full credit.

Section A

1. **(B)** {1, 2, 3}. *Working:* R = {(6, 1), (4, 2), (2, 3)}.

2. **(D)** $f(x) = x^3$. *Working:* Every real y has the pre-image $y^{1/3}$; the others never take negative values.

3. **(C)** $\frac{\pi}{3}$. *Working:* $\sin\frac{2\pi}{3} = \sin\frac{\pi}{3}$, and $\frac{\pi}{3}$ is in the principal range.

4. **(A)** $\frac{2\pi}{5}$. *Working:* $\tan^{-1}x + \cot^{-1}x = \frac{\pi}{2}$.

5. **(D)** $\alpha^2 + \beta\gamma = 1$. *Working:* The diagonal entries of A^2 are $\alpha^2 + \beta\gamma$.

6. **(C)** 9. *Working:* A(adj A) = |A| I, whose determinant is 3^2.

7. **(B)** 4. *Working:* 12 − 3x = 0.

8. **(A)** every integer. *Working:* Left and right limits differ at every integer.

9. **(A)** $3x^2$. *Working:* $y = x^3$.

10. **(D)** x = 2. *Working:* $f'(x) = 6(x-2)(x+1)$, and $f''(2) = 18 > 0$.

11. **(B)** $\log|1 + \tan x| + C$. *Working:* Put 1 + tan x = t.

12. **(C)** 1. *Working:* $[xe^x - e^x]_0^1 = 0 - (-1)$.

13. **(D)** 3. *Working:* The highest derivative is the third.

14. **(B)** $y'' + y = 0$. *Working:* Differentiating twice gives $y'' = -y$.

15. **(C)** $\frac{1}{\sqrt{14}}(2\hat{i} + 3\hat{j} + \hat{k})$. *Working:* $|\vec{a}| = \sqrt{14}$.

16. **(A)** $\vec{a} = \vec{0}$ or $\vec{b} = \vec{0}$. *Working:* Non-zero vectors cannot be both perpendicular and parallel.

17. **(A)** $\frac{2}{3}$. *Working:* P(E ∩ F) = 0.6 + 0.3 − 0.7 = 0.2; 0.2/0.3.

18. **(C)** the common region satisfying all the constraints, including non-negativity. *Working:* By definition.

19. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* $|\vec{a}|^2|\vec{b}|^2(\sin^2\theta + \cos^2\theta)$, so R explains A.

20. **(B)** Both A and R are true but R is not the correct explanation of A. *Working:* Both are true, but a zero diagonal does not make a matrix skew-symmetric; A holds because $A^T = -A$.

Section B

21. $\cot^{-1}(-\sqrt{3}) = \pi - \frac{\pi}{6} = \frac{5\pi}{6}$ (1). Value $= \frac{\pi}{3} - \frac{5\pi}{6} = -\frac{\pi}{2}$ (1).

OR $\sin^{-1}\frac{1}{5} + \cos^{-1}x = \frac{\pi}{2}$ (1). Since $\sin^{-1}a + \cos^{-1}a = \frac{\pi}{2}$, $x = \frac{1}{5}$ (1).

22. $\lim_{x\to 0}\frac{2\sin^2 2x}{8x^2} = \lim_{x\to 0}\left(\frac{\sin 2x}{2x}\right)^2 = 1$ (1½). So k = 1 (½).

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23. $f'(x) = 3x^2 - 6x + 4 = 3(x-1)^2 + 1$ (1), which is positive for all real x, so f is increasing on R (1).

OR $\frac{dV}{dt} = 3x^2\frac{dx}{dt}$, so $\frac{dx}{dt} = \frac{8}{432} = \frac{1}{54}$ (1). $\frac{dS}{dt} = 12x\frac{dx}{dt} = \frac{144}{54} = \frac{8}{3}$ cm²/s (1).

24. $\overrightarrow{AB} = \hat{i} + 4\hat{j} - 4\hat{k}$, $\overrightarrow{BC} = \hat{i} + 4\hat{j} - 4\hat{k}$ (1). They are equal and share B, so A, B, C are collinear (1).

25. ½ + p − ½p = 3/5 (1), so ½p = 1/10 and p = 1/5 (1).

Section C

26. $\frac{x}{(x^2+1)(x-1)} = \frac{1/2}{x-1} + \frac{-\frac{1}{2}x+\frac{1}{2}}{x^2+1}$ (1½). Integral $= \frac{1}{2}\log|x-1| - \frac{1}{4}\log(x^2+1) + \frac{1}{2}\tan^{-1}x + C$ (1½).

OR $\frac{1+\sin x}{1+\cos x} = \frac{1}{2}\sec^2\frac{x}{2} + \tan\frac{x}{2}$ (1½), of the form $f + f'$ with $f = \tan\frac{x}{2}$. Integral $= e^x\tan\frac{x}{2} + C$ (1½).

27. $\int_2^5 (5-x)\,dx + \int_5^8 (x-5)\,dx$ (1) $= \frac{9}{2} + \frac{9}{2} = 9$ (2).

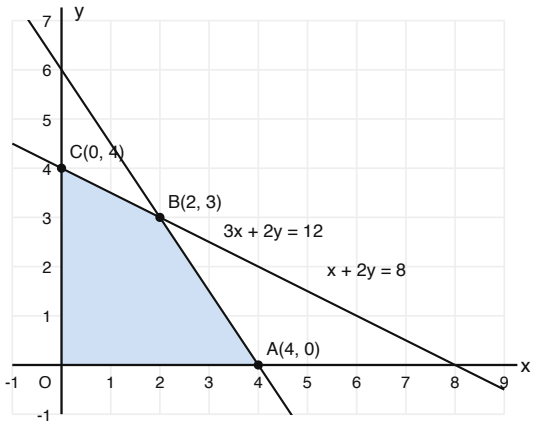
28. $\frac{dy}{dx} + \frac{2}{x}y = x\log x$; IF $= x^2$ (1). $yx^2 = \int x^3\log x\,dx = \frac{x^4}{4}\log x - \frac{x^4}{16} + C$ (1½). $y = \frac{x^2}{16}(4\log x - 1) + Cx^{-2}$ (½).

OR Put y = vx: $v + x\frac{dv}{dx} = 1 + v$ (1), so dv = dx/x and v = log|x| + C (1). y = x log|x| + Cx (1).

29. $\vec{a}\cdot\vec{b} = -1$, $|\vec{a}| = |\vec{b}| = \sqrt{3}$ (1½). $\cos\theta = -\frac{1}{3}$, so $\theta = \cos^{-1}\left(-\frac{1}{3}\right)$ (1½).

OR $\overrightarrow{AB} = \hat{i} + 2\hat{j} + 3\hat{k}$, $\overrightarrow{AC} = 4\hat{j} + 3\hat{k}$ (1). $\overrightarrow{AB}\times\overrightarrow{AC} = -6\hat{i} - 3\hat{j} + 4\hat{k}$ (1). Area $= \frac{1}{2}\sqrt{61}$ sq. units (1).

30. Corners O(0, 0), A(4, 0), B(2, 3), C(0, 4) (1½):



Z = 0, −12, 6, 16 (1). Minimum Z = −12 at (4, 0) (½).

31. F = {4, 5, …, 10}, 7 outcomes; E ∩ F = {4, 6, 8, 10} (1½). P(E|F) = 4/7 (1½).

Section D

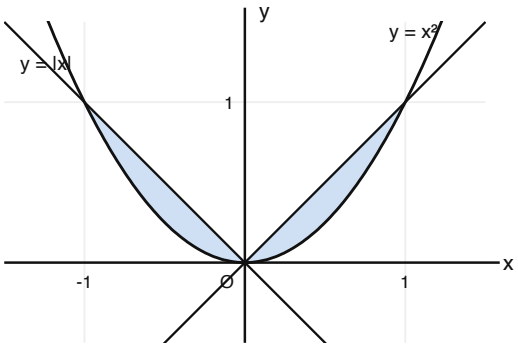
32. f(2) = 2/5 = f(½), so f is not one-one (2). For $y = \frac{x}{x^2+1}$, $yx^2 - x + y = 0$ has real x only if $1 - 4y^2 \geq 0$, i.e. $|y| \leq \frac{1}{2}$ (2). So, for example, 1 has no pre-image and f is not onto (1).

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OR a – a = 0 is divisible by 2 (1). If 2 | a – b then 2 | b – a (1). If 2 | a – b and 2 | b – c then 2 | a – c (1). [0] is the set of all even integers {…, –4, –2, 0, 2, 4, …} (2).

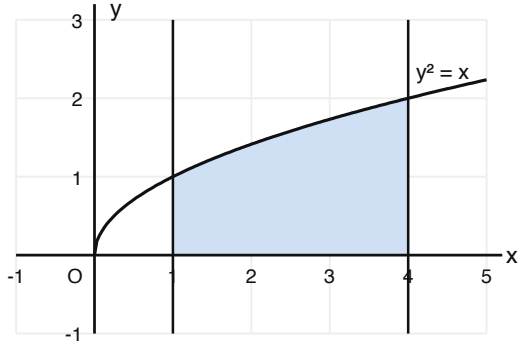
33. x + y + z = 6, y + 3z = 11, x – 2y + z = 0 (1). $A = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 1 & 3 \\ 1 & -2 & 1 \end{bmatrix}$, |A| = 9 (1). $\operatorname{adj} A = \begin{bmatrix} 7 & -3 & 2 \\ 3 & 0 & -3 \\ -1 & 3 & 1 \end{bmatrix}$ (1½). $X = \frac{1}{9} \operatorname{adj} A \begin{bmatrix} 6 \\ 11 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$: the numbers are 1, 2 and 3 (1½).

34. They meet at x = –1, 0, 1 (1). Figure (1):



By symmetry, area $= 2\int_0^1 (x - x^2)\,dx$ (1) $= 2\left(\frac{1}{2} - \frac{1}{3}\right) = \frac{1}{3}$ sq. units (2).

OR Figure (1):



Area $= \int_1^4 \sqrt{x}\,dx$ (2) $= \frac{2}{3}\left[x^{3/2}\right]_1^4 = \frac{2}{3}(8 - 1) = \frac{14}{3}$ sq. units (2).

35. Using $x \to \frac{\pi}{2} - x$, $I = \int_0^{\pi/2} \log\cos x\,dx$ (1). $2I = \int_0^{\pi/2} \log\left(\frac{\sin 2x}{2}\right) dx = \int_0^{\pi/2} \log\sin 2x\,dx - \frac{\pi}{2}\log 2$ (1½). Put 2x = t: $\int_0^{\pi/2} \log\sin 2x\,dx = \frac{1}{2}\int_0^{\pi} \log\sin t\,dt = I$ (1½). So $I = -\frac{\pi}{2}\log 2$ (1).

Section E

36. (i) $R'(x) = 6x + 36$.

(ii) ₹66.

(iii) 6x + 36 = 96 gives x = 10 units. **OR** $R'(x) = 6x + 36 > 0$ for x ≥ 0, so R is increasing.

37. (i) 0.001 × 0.99 = 0.00099.

(ii) 0.00099 + 0.999 × 0.005 = 0.005985.

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(iii) $\frac{0.00099}{0.005985} = \frac{22}{133}$ (about 0.165). **OR** $1 - \frac{22}{133} = \frac{111}{133}$.

38. (i) (5, 4, 1) (1); distance $\sqrt{25 + 16 + 1} = \sqrt{42}$ units (1).

(ii) For the foot of the perpendicular, $\overrightarrow{OP} \cdot (2\hat{i} + \hat{j} - \hat{k}) = 0$: 1 + 6λ = 0, λ = −1/6 (1). The point is $\left(\frac{2}{3}, \frac{11}{6}, \frac{19}{6}\right)$ (1).

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