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Your JEE Guide

CBSE Class XII · Mathematics (041)

Sample Question Paper 2 · 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 number of equivalence relations on the set {1, 2, 3} that contain (1, 2) is: (A) 4 (B) 3 (C) 1 (D) 2	1
2.	The function f: R → R, f(x) = x², is: (A) one-one but not onto (B) one-one and onto (C) neither one-one nor onto (D) onto but not one-one	1
3.	The value of $\cos^{-1}\left(\cos\frac{7\pi}{6}\right)$ is: (A) $\frac{5\pi}{6}$ (B) $\frac{\pi}{6}$ (C) $-\frac{\pi}{6}$ (D) $\frac{7\pi}{6}$	1
4.	The domain of $\sin^{-1}(2x)$ is: (A) [–2, 2] (B) $\left[-\frac{1}{2}, \frac{1}{2}\right]$ (C) [0, 1] (D) [–1, 1]	1

5.	If A and B are symmetric matrices of the same order, then AB – BA is: (A) a zero matrix (B) skew-symmetric (C) symmetric (D) an identity matrix	1
6.	If $\begin{vmatrix} 2x & 5 \\ 8 & x \end{vmatrix} = \begin{vmatrix} 6 & -2 \\ 7 & 3 \end{vmatrix}$, then x is: (A) 6 (B) ±3 (C) ±6 (D) –6	1
7.	If A is an invertible matrix of order 3 and |A| = 5, then |adj A| is: (A) 25 (B) $\frac{1}{5}$ (C) 5 (D) 125	1
8.	The function f(x) = |x – 1| is not differentiable at: (A) any real x (B) x = 0 (C) x = –1 (D) x = 1	1
9.	If $y = \log(\cos e^x)$, then $\frac{dy}{dx}$ is: (A) $e^x \tan e^x$ (B) $-e^x \tan e^x$ (C) $e^x \cot e^x$ (D) $-\tan e^x$	1
10.	The rate of change of the area of a circle with respect to its radius r, at r = 6 cm, is: (A) 12π cm²/cm (B) 24π cm²/cm (C) 6π cm²/cm (D) 36π cm²/cm	1
11.	$\int \frac{dx}{x^2+4}$ equals: (A) $\tan^{-1}\frac{x}{2} + C$ (B) $2\tan^{-1}\frac{x}{2} + C$ (C) $\frac{1}{4}\tan^{-1}\frac{x}{4} + C$ (D) $\frac{1}{2}\tan^{-1}\frac{x}{2} + C$	1
12.	$\int_{-1}^{1} x^3 \cos x \, dx$ equals: (A) 2 (B) 1 (C) 0 (D) $\cos 1$	1
13.	The general solution of $\frac{dy}{dx} = e^{x+y}$ is: (A) $e^x - e^y = C$ (B) $e^{-x} + e^y = C$ (C) $e^x + e^{-y} = C$ (D) $e^{x+y} = C$	1
14.	The number of arbitrary constants in a particular solution of a third-order differential equation is: (A) 0 (B) 3 (C) 2 (D) 1	1

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15.	If $\lvert\vec{a}\rvert = 3$, $\lvert\vec{b}\rvert = 4$ and $\vec{a}\cdot\vec{b} = 6$, the angle between $\vec{a}$ and $\vec{b}$ is: (A) $\frac{\pi}{4}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{2}$ (D) $\frac{\pi}{3}$	1
16.	The value of λ for which $2\hat{i} + \lambda\hat{j} + \hat{k}$ and $\hat{i} - 2\hat{j} + 3\hat{k}$ are perpendicular is: (A) $-\frac{5}{2}$ (B) $\frac{5}{2}$ (C) 3 (D) 2	1
17.	A line has direction ratios 1, –2, 2. Its direction cosines are: (A) 1, –2, 2 (B) $\frac{1}{3}, -\frac{2}{3}, \frac{2}{3}$ (C) $\frac{1}{5}, -\frac{2}{5}, \frac{2}{5}$ (D) $-\frac{1}{3}, \frac{2}{3}, \frac{2}{3}$	1
18.	Two cards are drawn one after the other without replacement from a pack of 52. The probability that both are kings is: (A) $\frac{1}{169}$ (B) $\frac{2}{13}$ (C) $\frac{1}{13}$ (D) $\frac{1}{221}$	1
19.	**Assertion (A):** In an LPP, the optimal value of the objective function, if it exists, occurs at a corner point of the feasible region. **Reason (R):** The feasible region of every LPP is bounded. (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 function $f(x) = e^x$ is increasing on R. **Reason (R):** $f'(x) = e^x > 0$ for all real x. (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 $\cos^{-1}\frac{1}{2} + 2\sin^{-1}\frac{1}{2}$. **OR** Prove that $3\sin^{-1}x = \sin^{-1}(3x - 4x^3)$, $x \in \left[-\frac{1}{2}, \frac{1}{2}\right]$.	2
22.	Find $\frac{dy}{dx}$ if $y = x^{\sin x}$, x > 0.	2

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23.	Find the rate of change of the volume of a sphere with respect to its radius when the radius is 10 cm. **OR** The radius of a circle is increasing at 0.7 cm/s. At what rate is its circumference increasing?	2
24.	Find the area of the parallelogram whose adjacent sides are $\vec{a} = 3\hat{i} + \hat{j} + 4\hat{k}$ and $\vec{b} = \hat{i} - \hat{j} + \hat{k}$.	2
25.	Given P(A) = 0.6, P(B) = 0.3 and P(A ∩ B) = 0.2, find P(A|B) and P(B|A).	2

Section C

26.	Find $\int \frac{dx}{x^2 - 6x + 13}$. **OR** Find $\int \sin^3 x \cos^2 x \, dx$.	3
27.	Evaluate $\int_1^4 \lvert x - 2 \rvert \, dx$. **OR** Evaluate $\int_0^{\pi/4} \log(1 + \tan x) \, dx$.	3
28.	Solve the differential equation $x\frac{dy}{dx} = y + \sqrt{x^2 + y^2}$, x > 0.	3
29.	Find the vector and cartesian equations of the line through (1, 2, –4) perpendicular to both the lines $\frac{x-8}{3} = \frac{y+19}{-16} = \frac{z-10}{7}$ and $\frac{x-15}{3} = \frac{y-29}{8} = \frac{z-5}{-5}$.	3
30.	Solve graphically: minimise Z = 200x + 500y subject to x + 2y ≥ 10, 3x + 4y ≤ 24, x ≥ 0, y ≥ 0. **OR** Solve graphically: maximise Z = 3x + 4y subject to x + y ≤ 4, x ≥ 0, y ≥ 0.	3
31.	A family has two children. Find the probability that both are boys if (i) at least one of them is a boy, (ii) the elder child is a boy.	3

Section D

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32.	Solve the system using matrices: 2x + 3y + 3z = 5, x – 2y + z = –4, 3x – y – 2z = 3. **OR** Find the product $\begin{bmatrix}1 & -1 & 2\\ 0 & 2 & -3\\ 3 & -2 & 4\end{bmatrix}\begin{bmatrix}-2 & 0 & 1\\ 9 & 2 & -3\\ 6 & 1 & -2\end{bmatrix}$ and use it to solve x – y + 2z = 1, 2y – 3z = 1, 3x – 2y + 4z = 2.	5
33.	Show that, of all rectangles inscribed in a given fixed circle, the square has the maximum area.	5
34.	Evaluate $\int_0^{\pi} \frac{x}{a^2\cos^2 x + b^2 \sin^2 x}\, dx.$	5
35.	Using integration, find the area of the region bounded by the parabola $y^2 = 4x$ and the line x = 3. **OR** Using integration, find the area of the region bounded by the line y = 3x + 2, the x-axis and the ordinates x = –1 and x = 1.	5

Section E

36.	**Case study 1.** A 5 m ladder leans against a vertical wall. Its foot is pulled away from the wall along the ground at 2 cm/s. Let x be the distance of the foot from the wall and y the height of the top. (i) Write the relation between x and y. *[1]* (ii) Find y when the foot is 4 m from the wall. *[1]* (iii) How fast is the top of the ladder sliding down when the foot is 4 m from the wall? *[2]* **OR** (iii) How fast is the top sliding down when the foot is 3 m from the wall? *[2]*	4
37.	**Case study 2.** A factory has three machines A, B and C, which make 50%, 30% and 20% of its bolts. Of their output, 2%, 3% and 4% respectively are defective. A bolt is picked at random. (i) Find the probability that the bolt was made by A and is defective. *[1]* (ii) Find the probability that the bolt is defective. *[1]* (iii) The bolt is found to be defective. Find the probability that it was made by machine A. *[2]* **OR** (iii) The bolt is found to be defective. Find the probability that it was made by machine C. *[2]*	4

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38.	**Case study 3.** A trust invests ₹30 000 in two bonds. The first pays 5% interest per year and the second 7%. The total yearly interest is ₹1800. Let ₹x and ₹y be the amounts in the two bonds. (i) Write the equations in matrix form AX = B. *[2]* (ii) Using the inverse of the coefficient matrix, find x and y. *[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. **(D)** 2. *Working:* The smallest such relation {(1,1),(2,2),(3,3),(1,2),(2,1)} and the universal relation.

2. **(C)** neither one-one nor onto. *Working:* f(–1) = f(1), and negative numbers have no pre-image.

3. **(A)** $\frac{5\pi}{6}$. *Working:* $\cos\frac{7\pi}{6} = \cos\frac{5\pi}{6}$ and $\frac{5\pi}{6} \in [0, \pi]$.

4. **(B)** $\left[-\frac{1}{2}, \frac{1}{2}\right]$. *Working:* –1 ≤ 2x ≤ 1.

5. **(B)** skew-symmetric. *Working:* $(AB - BA)^T = BA - AB = -(AB - BA)$.

6. **(C)** ±6. *Working:* $2x^2 - 40 = 18 + 14$, so $x^2 = 36$.

7. **(A)** 25. *Working:* $|\operatorname{adj} A| = |A|^{n-1} = 5^2$.

8. **(D)** x = 1. *Working:* The left and right derivatives at x = 1 are –1 and 1.

9. **(B)** $-e^x \tan e^x$. *Working:* $\frac{1}{\cos e^x} \cdot (-\sin e^x) \cdot e^x$.

10. **(A)** 12π cm²/cm. *Working:* $\frac{dA}{dr} = 2\pi r$.

11. **(D)** $\frac{1}{2}\tan^{-1}\frac{x}{2} + C$. *Working:* $\int \frac{dx}{x^2+a^2} = \frac{1}{a}\tan^{-1}\frac{x}{a} + C$.

12. **(C)** 0. *Working:* The integrand is an odd function.

13. **(C)** $e^x + e^{-y} = C$. *Working:* $e^{-y}dy = e^x dx$ gives $-e^{-y} = e^x + c$.

14. **(A)** 0. *Working:* A particular solution has no arbitrary constants.

15. **(D)** $\frac{\pi}{3}$. *Working:* $\cos\theta = \frac{6}{12} = \frac{1}{2}$.

16. **(B)** $\frac{5}{2}$. *Working:* 2 – 2λ + 3 = 0.

17. **(B)** $\frac{1}{3}, -\frac{2}{3}, \frac{2}{3}$. *Working:* Divide by $\sqrt{1+4+4} = 3$.

18. **(D)** $\frac{1}{221}$. *Working:* $\frac{4}{52} \times \frac{3}{51}$.

19. **(C)** A is true but R is false. *Working:* A is the corner-point theorem. R is false: feasible regions can be unbounded.

20. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* A positive derivative everywhere means f is increasing.

Section B

21. $\frac{\pi}{3} + 2 \cdot \frac{\pi}{6}$ (1) $= \frac{2\pi}{3}$ (1).

OR Put x = sin θ, so $\theta \in \left[-\frac{\pi}{6}, \frac{\pi}{6}\right]$ (½). $3x - 4x^3 = \sin 3\theta$ and $3\theta \in \left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$ (1), so RHS = 3θ = LHS (½).

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22. $\log y = \sin x \log x$ (½). $\frac{1}{y}\frac{dy}{dx} = \cos x \log x + \frac{\sin x}{x}$ (1). $\frac{dy}{dx} = x^{\sin x}\left(\cos x \log x + \frac{\sin x}{x}\right)$ (½).

23. $V = \frac{4}{3}\pi r^3$, $\frac{dV}{dr} = 4\pi r^2$ (1). At r = 10: 400π cm³/cm (1).

OR $C = 2\pi r$, $\frac{dC}{dt} = 2\pi\frac{dr}{dt}$ (1) $= 1.4\pi$ cm/s (1).

24. $\vec{a} \times \vec{b} = 5\hat{i} + \hat{j} - 4\hat{k}$ (1). Area $= \sqrt{25 + 1 + 16} = \sqrt{42}$ sq. units (1).

25. $P(A|B) = \frac{0.2}{0.3} = \frac{2}{3}$ (1). $P(B|A) = \frac{0.2}{0.6} = \frac{1}{3}$ (1).

Section C

26. $x^2 - 6x + 13 = (x-3)^2 + 2^2$ (1½). Integral $= \frac{1}{2}\tan^{-1}\frac{x-3}{2} + C$ (1½).

OR $\sin^3 x = (1 - \cos^2 x)\sin x$; put cos x = t, dt = –sin x dx (1). $-\int (t^2 - t^4)\,dt$ (1) $= -\frac{\cos^3 x}{3} + \frac{\cos^5 x}{5} + C$ (1).

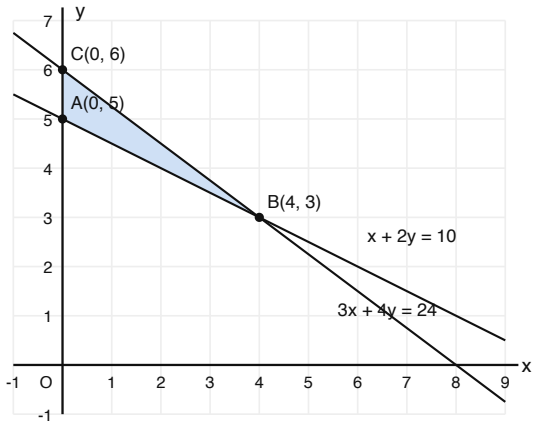
27. $\int_1^2 (2 - x)\,dx + \int_2^4 (x - 2)\,dx$ (1) $= \frac{1}{2} + 2$ (1½) $= \frac{5}{2}$ (½).

OR Using $x \to \frac{\pi}{4} - x$: $1 + \tan(\frac{\pi}{4} - x) = \frac{2}{1+\tan x}$ (1). So $I = \int_0^{\pi/4} \log 2\,dx - I$ (1), and $I = \frac{\pi}{8}\log 2$ (1).

28. Homogeneous; put y = vx: $v + x\frac{dv}{dx} = v + \sqrt{1+v^2}$ (1). $\int \frac{dv}{\sqrt{1+v^2}} = \int \frac{dx}{x}$: $\log|v + \sqrt{1+v^2}| = \log x + \log C$ (1). $y + \sqrt{x^2+y^2} = Cx^2$ (1).

29. Required direction $= \vec{b}_1 \times \vec{b}_2 = 24\hat{i} + 36\hat{j} + 72\hat{k}$, i.e. parallel to $2\hat{i} + 3\hat{j} + 6\hat{k}$ (1½). $\vec{r} = (\hat{i} + 2\hat{j} - 4\hat{k}) + \lambda(2\hat{i} + 3\hat{j} + 6\hat{k})$ (1); $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z+4}{6}$ (½).

30. Feasible region with corners A(0, 5), B(4, 3), C(0, 6) (1½):



Z = 2500, 2300, 3000 (1). Minimum Z = 2300 at (4, 3) (½).

OR Corners (0, 0), (4, 0), (0, 4) (1½). Z = 0, 12, 16 (1). Maximum Z = 16 at (0, 4) (½).

31. Sample space {BB, BG, GB, GG} (½). (i) At least one boy: {BB, BG, GB}; P = 1/3 (1½). (ii) Elder a boy: {BB, BG}; P = 1/2 (1).

Section D

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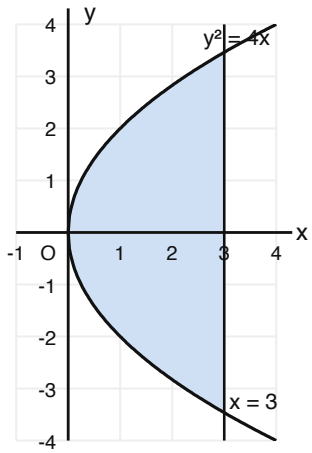
32. $A = \begin{bmatrix} 2 & 3 & 3 \\ 1 & -2 & 1 \\ 3 & -1 & -2 \end{bmatrix}$, |A| = 40 ≠ 0 (1). $\operatorname{adj} A = \begin{bmatrix} 5 & 3 & 9 \\ 5 & -13 & 1 \\ 5 & 11 & -7 \end{bmatrix}$ (2). $X = \frac{1}{40} \operatorname{adj} A \cdot \begin{bmatrix} 5 \\ -4 \\ 3 \end{bmatrix} = \begin{bmatrix} 1 \\ 2 \\ -1 \end{bmatrix}$ (1½). x = 1, y = 2, z = –1 (½).

OR The product is I (2), so the inverse of the coefficient matrix A is the second matrix (1). $X = A^{-1} \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix} = \begin{bmatrix} 0 \\ 5 \\ 3 \end{bmatrix}$: x = 0, y = 5, z = 3 (2).

33. Let the circle have radius a, and the rectangle sides x and y with $x^2 + y^2 = 4a^2$ (1). $A = x\sqrt{4a^2 - x^2}$; work with $S = A^2 = 4a^2x^2 - x^4$ (1). $\frac{dS}{dx} = 8a^2x - 4x^3 = 0$ gives $x = \sqrt{2}a$ (1). $\frac{d^2S}{dx^2} = 8a^2 - 12x^2 = -16a^2 < 0$: maximum (1). Then $y = \sqrt{2}a = x$, so the rectangle is a square (1).

34. Using $x \to \pi - x$: $2I = \pi \int_0^{\pi} \frac{dx}{a^2\cos^2 x + b^2 \sin^2 x} = 2\pi \int_0^{\pi/2} \frac{dx}{a^2\cos^2 x + b^2 \sin^2 x}$ (2). Divide by $\cos^2 x$ and put tan x = t: $2\pi \int_0^{\infty} \frac{dt}{a^2 + b^2 t^2} = 2\pi \cdot \frac{1}{ab} \cdot \frac{\pi}{2}$ (2). $I = \frac{\pi^2}{2ab}$ (1).

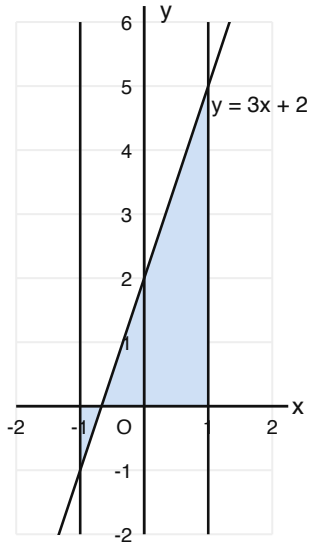
35. Figure (1):



By symmetry, area $= 2\int_0^3 2\sqrt{x}\,dx$ (2) $= 4 \cdot \frac{2}{3} \cdot 3^{3/2} = 8\sqrt{3}$ sq. units (2).

OR Figure (1):

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The line meets the x-axis at $x = -\frac{2}{3}$ (1). Area $= \left|\int_{-1}^{-2/3}(3x+2)dx\right| + \int_{-2/3}^{1}(3x+2)dx =$ $\frac{1}{6} + \frac{25}{6}$ (2) $= \frac{13}{3}$ sq. units (1).

Section E

36. (i) $x^2 + y^2 = 25$ (in metres).

(ii) y = 3 m.

(iii) $2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 0$, so $\frac{dy}{dt} = -\frac{4}{3} \times 2 = -\frac{8}{3}$ cm/s: it slides down at $\frac{8}{3}$ cm/s. **OR** Then y = 4, so $\frac{dy}{dt} = -\frac{3}{4} \times 2 = -\frac{3}{2}$ cm/s: 1.5 cm/s downwards.

37. (i) 0.5 × 0.02 = 0.01.

(ii) 0.01 + 0.009 + 0.008 = 0.027.

(iii) $\frac{0.01}{0.027} = \frac{10}{27}$. **OR** $\frac{0.008}{0.027} = \frac{8}{27}$.

38. (i) $\begin{bmatrix}1 & 1\\ 5 & 7\end{bmatrix}\begin{bmatrix}x\\ y\end{bmatrix} = \begin{bmatrix}30000\\ 180000\end{bmatrix}$ (from x + y = 30 000 and 0.05x + 0.07y = 1800).

(ii) |A| = 2, $A^{-1} = \frac{1}{2}\begin{bmatrix}7 & -1\\ -5 & 1\end{bmatrix}$. $X = \frac{1}{2}\begin{bmatrix}30000\\ 30000\end{bmatrix} = \begin{bmatrix}15000\\ 15000\end{bmatrix}$: ₹15 000 in each bond.

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