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Your JEE Guide

CBSE Class XII · Mathematics (041)

Sample Question Paper 6 · 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.	Let A = {a, b, c} and R = {(a, a), (b, b), (c, c), (a, b)}. Then R is: (A) reflexive and transitive but not symmetric (B) symmetric but not transitive (C) an equivalence relation (D) neither reflexive nor transitive	1
2.	The function f: R → R, f(x) = sin x, 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 principal value of $\operatorname{cosec}^{-1} 2$ is: (A) $\frac{\pi}{3}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{4}$ (D) $\frac{5\pi}{6}$	1
4.	The value of $\tan^{-1}(-1) + \cos^{-1}\left(-\frac{1}{\sqrt{2}}\right)$ is: (A) 0 (B) $\frac{\pi}{4}$ (C) π (D) $\frac{\pi}{2}$	1

5.	For square matrices A and B, $(A+B)^2 = A^2 + 2AB + B^2$ holds if: (A) AB = O (B) A and B are symmetric (C) A = O (D) AB = BA	1
6.	The number of possible orders of a matrix with 8 elements is: (A) 8 (B) 4 (C) 2 (D) 3	1
7.	The value of $\begin{vmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{vmatrix}$ is: (A) $\cos 2\theta$ (B) 0 (C) 1 (D) –1	1
8.	The value of k for which $f(x) = \begin{cases} kx+1, & x \le \pi \\ \cos x, & x > \pi \end{cases}$ is continuous at x = π is: (A) $-\frac{2}{\pi}$ (B) $\frac{\pi}{2}$ (C) $-\frac{\pi}{2}$ (D) $\frac{2}{\pi}$	1
9.	$\frac{d}{dx}\log(\log x)$, x > 1, is: (A) $\frac{1}{x\log x}$ (B) $\frac{\log x}{x}$ (C) $\frac{1}{x}$ (D) $\frac{1}{\log x}$	1
10.	The function $f(x) = e^{-x}$ is: (A) constant (B) decreasing on R (C) increasing on R (D) increasing only for x > 0	1
11.	$\int \frac{dx}{\sqrt{1-x^2}}$ equals: (A) $\log\left\lvert x+\sqrt{1-x^2}\right\rvert + C$ (B) $\sqrt{1-x^2}+C$ (C) $\sin^{-1}x + C$ (D) $\tan^{-1}x + C$	1
12.	$\int_0^1 \frac{dx}{1+x^2}$ equals: (A) $\log 2$ (B) $\frac{\pi}{2}$ (C) 1 (D) $\frac{\pi}{4}$	1
13.	The order and degree of $y' + 5y = 0$ are: (A) 2 and 1 (B) 1 and 1 (C) 1 and 0 (D) 0 and 1	1
14.	The general solution of x dy – y dx = 0 is: (A) y = Cx (B) xy = C (C) x + y = C (D) $y = Cx^2$	1

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15.	The area of the parallelogram whose diagonals are $3\hat{i}+\hat{j}-2\hat{k}$ and $\hat{i}-3\hat{j}+4\hat{k}$ is: (A) $10\sqrt{3}$ (B) 5 (C) $5\sqrt{3}$ (D) 15	1
16.	The direction ratios of the line $\frac{x-1}{2}=\frac{3-y}{4}=\frac{z+1}{-3}$ are: (A) –2, 4, 3 (B) 2, 4, –3 (C) 1, 3, –1 (D) 2, –4, –3	1
17.	If A and B are independent with P(A) = 0.3 and P(B) = 0.6, the probability that neither occurs is: (A) 0.9 (B) 0.28 (C) 0.18 (D) 0.72	1
18.	The corner points of a feasible region are (0, 4), (2, 2) and (4, 0). The minimum value of Z = 3x + 2y is: (A) 8 (B) 12 (C) 0 (D) 10	1
19.	**Assertion (A):** $(AB)^T=B^TA^T$ for matrices A and B for which AB is defined. **Reason (R):** $(A+B)^T=A^T+B^T$ for matrices of the same order. (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):** f(x) = tan x is continuous at every point of its domain. **Reason (R):** tan x = sin x / cos x is the quotient of two continuous functions. (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.	Write $\tan^{-1}\left(\frac{\cos x}{1-\sin x}\right)$, $-\frac{3\pi}{2}<x<\frac{\pi}{2}$, in the simplest form. **OR** Find the value of $\cos\left(\sec^{-1}x+\operatorname{cosec}^{-1}x\right)$, $\lvert x\rvert \geq 1$.	2
22.	Find $\frac{dy}{dx}$ if $y=(\cos x)^x$.	2

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23.	A stone is dropped into a still lake and circular waves spread out. The radius increases at 5 cm/s. How fast is the enclosed area increasing when the radius is 8 cm? **OR** Find the intervals in which $f(x) = -2x^3 - 9x^2 - 12x + 1$ is increasing or decreasing.	2
24.	If $\vec{a} = 2\hat{i} + 2\hat{j} + 3\hat{k}$, $\vec{b} = -\hat{i} + 2\hat{j} + \hat{k}$ and $\vec{c} = 3\hat{i} + \hat{j}$, find λ such that $\vec{a} + \lambda\vec{b}$ is perpendicular to $\vec{c}$.	2
25.	P(A) = 7/13, P(B) = 9/13 and P(A ∩ B) = 4/13. Find P(A′|B).	2

Section C

26.	Find $\int \frac{x^2 + x + 1}{(x+2)(x^2+1)}\, dx$. **OR** Find $\int \sin^{-1} x\, dx$.	3
27.	Evaluate $\int_0^{\pi/2} \frac{\sin x - \cos x}{1 + \sin x \cos x}\, dx$.	3
28.	Find the particular solution of $(1 + x^2)\frac{dy}{dx} + 2xy = \frac{1}{1+x^2}$, given y = 0 when x = 1. **OR** Solve y dx – (x + 2y²) dy = 0.	3
29.	Find the shortest distance between the lines $\vec{r} = (1 - t)\hat{i} + (t - 2)\hat{j} + (3 - 2t)\hat{k}$ and $\vec{r} = (s + 1)\hat{i} + (2s - 1)\hat{j} - (2s + 1)\hat{k}$. **OR** Find the direction cosines of the line through the points (–2, 4, –5) and (1, 2, 3).	3
30.	Solve graphically: find the minimum and maximum of Z = 3x + 9y subject to x + 3y ≤ 60, x + y ≥ 10, x ≤ y, x ≥ 0, y ≥ 0.	3
31.	Two groups compete for the board of a company. The chances of the two groups winning are 0.6 and 0.4. If the first group wins, the probability of a new product being introduced is 0.7; if the second wins, it is 0.3. A new product is introduced. Find the probability that the second group won.	3

Section D

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32.	Show that the relation R on the set of real numbers, R = {(a, b): a ≤ b}, is reflexive and transitive but not symmetric. **OR** Show that f: R → R, f(x) = 3 − 4x, is one-one and onto.	5
33.	4 kg onions, 3 kg wheat and 2 kg rice cost ₹60; 2 kg onions, 4 kg wheat and 6 kg rice cost ₹90; 6 kg onions, 2 kg wheat and 3 kg rice cost ₹70. Find the cost of each item per kg using matrices.	5
34.	Using integration, find the area of the region bounded by the parabola $y = x^2$ and the line y = 4. **OR** Using integration, find the area of the triangle with vertices A(1, 0), B(2, 2) and C(3, 1).	5
35.	Find $\int \frac{x^2}{(x^2+1)(x^2+4)}\,dx.$	5

Section E

36.	**Case study 1.** A spherical balloon is being inflated so that its volume increases at 900 cm³/s. (i) Write the volume V in terms of the radius r. *[1]* (ii) Find $\frac{dV}{dr}$ when r = 15 cm. *[1]* (iii) How fast is the radius increasing when r = 15 cm? *[2]* **OR** (iii) How fast is the surface area increasing when r = 15 cm? *[2]*	4
37.	**Case study 2.** A farmer buys 60% of his seeds from company X and 40% from company Y. Seeds from X germinate 90% of the time and those from Y 80% of the time. A seed is chosen at random. (i) Find the probability that the seed is from X and germinates. *[1]* (ii) Find the probability that the seed germinates. *[1]* (iii) The seed germinated. Find the probability that it came from X. *[2]* **OR** (iii) The seed did not germinate. Find the probability that it came from Y. *[2]*	4
38.	**Case study 3.** The marginal cost of producing x units of an item is $MC = 2x + 3$ (in ₹), and the fixed cost is ₹50. (i) Find the total cost function C(x). *[2]* (ii) Find the cost of producing 10 units. *[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. **(A)** reflexive and transitive but not symmetric. *Working:* All (x, x) are present; (a, b) ∈ R but (b, a) ∉ R; no pair breaks transitivity.

2. **(C)** neither one-one nor onto. *Working:* sin 0 = sin π, and 2 is not a value of sin x.

3. **(B)** $\frac{\pi}{6}$. *Working:* cosec(π/6) = 2.

4. **(D)** $\frac{\pi}{2}$. *Working:* $-\frac{\pi}{4} + \frac{3\pi}{4}$.

5. **(D)** AB = BA. *Working:* $(A+B)^2 = A^2 + AB + BA + B^2$.

6. **(B)** 4. *Working:* 1 × 8, 8 × 1, 2 × 4, 4 × 2.

7. **(C)** 1. *Working:* $\cos^2\theta + \sin^2\theta$.

8. **(A)** $-\frac{2}{\pi}$. *Working:* kπ + 1 = cos π = −1.

9. **(A)** $\frac{1}{x \log x}$. *Working:* Chain rule.

10. **(B)** decreasing on R. *Working:* $f'(x) = -e^{-x} < 0$.

11. **(C)** $\sin^{-1} x + C$. *Working:* Standard integral.

12. **(D)** $\frac{\pi}{4}$. *Working:* $\tan^{-1} 1 - \tan^{-1} 0$.

13. **(B)** 1 and 1. *Working:* First derivative only, of power 1.

14. **(A)** y = Cx. *Working:* $\frac{dy}{y} = \frac{dx}{x}$.

15. **(C)** $5\sqrt{3}$. *Working:* $\frac{1}{2}|\vec{d}_1 \times \vec{d}_2| = \frac{1}{2}|-2\hat{i} - 14\hat{j} - 10\hat{k}| = \frac{1}{2}\sqrt{300}$.

16. **(D)** 2, −4, −3. *Working:* Write the middle term as $\frac{y-3}{-4}$.

17. **(B)** 0.28. *Working:* 0.7 × 0.4.

18. **(A)** 8. *Working:* Z = 8, 10, 12.

19. **(B)** Both A and R are true but R is not the correct explanation of A. *Working:* Both are true properties of transposes, but R is about sums and does not explain A.

20. **(A)** Both Assertion (A) and Reason (R) are true and R is the correct explanation of A. *Working:* A quotient of continuous functions is continuous wherever the denominator is non-zero.

Section B

21. $\frac{\cos x}{1-\sin x} = \frac{\cos^2\frac{x}{2} - \sin^2\frac{x}{2}}{(\cos\frac{x}{2} - \sin\frac{x}{2})^2} = \frac{1+\tan\frac{x}{2}}{1-\tan\frac{x}{2}} = \tan\left(\frac{\pi}{4} + \frac{x}{2}\right)$ (1½). So the expression is $\frac{\pi}{4} + \frac{x}{2}$ (½).

OR $\sec^{-1} x + \operatorname{cosec}^{-1} x = \frac{\pi}{2}$ (1), so the value is $\cos\frac{\pi}{2} = 0$ (1).

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

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23. $\frac{dA}{dt} = 2\pi r \frac{dr}{dt}$ (1) $= 2\pi \times 8 \times 5 = 80\pi$ cm²/s (1).

OR $f'(x) = -6(x+1)(x+2)$ (½). Increasing on (–2, –1) (1); decreasing on $(-\infty, -2) \cup (-1, \infty)$ (½).

24. $\vec{a} + \lambda\vec{b} = (2-\lambda)\hat{i} + (2+2\lambda)\hat{j} + (3+\lambda)\hat{k}$ (1). Dot with $\vec{c}$: 3(2 − λ) + (2 + 2λ) = 8 − λ = 0, so λ = 8 (1).

25. P(A′ ∩ B) = P(B) − P(A ∩ B) = 5/13 (1). P(A′|B) = (5/13)/(9/13) = 5/9 (1).

Section C

26. $\frac{x^2+x+1}{(x+2)(x^2+1)} = \frac{3/5}{x+2} + \frac{\frac{2}{5}x+\frac{1}{5}}{x^2+1}$ (1½). Integral $= \frac{3}{5}\log|x+2| + \frac{1}{5}\log(x^2+1) + \frac{1}{5}\tan^{-1}x + C$ (1½).

OR By parts: $x\sin^{-1}x - \int \frac{x}{\sqrt{1-x^2}}dx$ (1½) $= x\sin^{-1}x + \sqrt{1-x^2} + C$ (1½).

27. Using $x \to \frac{\pi}{2} - x$, the integrand becomes $\frac{\cos x - \sin x}{1+\sin x\cos x}$, so I = –I (2). Hence I = 0 (1).

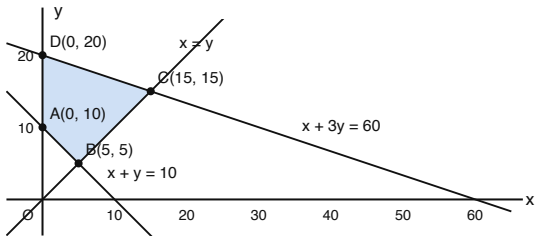
28. The left side is $\frac{d}{dx}[y(1+x^2)]$ (1). $y(1+x^2) = \tan^{-1}x + C$ (1). y(1) = 0 gives $C = -\frac{\pi}{4}$: $y = \frac{\tan^{-1}x - \frac{\pi}{4}}{1+x^2}$ (1).

OR $\frac{dx}{dy} - \frac{x}{y} = 2y$; IF $= \frac{1}{y}$ (1). $\frac{x}{y} = \int 2\,dy = 2y + C$ (1½). $x = 2y^2 + Cy$ (½).

29. $\vec{a}_1 = \hat{i} - 2\hat{j} + 3\hat{k}$, $\vec{b}_1 = -\hat{i} + \hat{j} - 2\hat{k}$; $\vec{a}_2 = \hat{i} - \hat{j} - \hat{k}$, $\vec{b}_2 = \hat{i} + 2\hat{j} - 2\hat{k}$ (1). $\vec{b}_1 \times \vec{b}_2 = 2\hat{i} - 4\hat{j} - 3\hat{k}$; $(\vec{a}_2 - \vec{a}_1)\cdot(\vec{b}_1 \times \vec{b}_2) = 8$ (1). SD $= \frac{8}{\sqrt{29}}$ units (1).

OR Direction ratios 3, –2, 8 (1); their magnitude is $\sqrt{77}$ (1). Direction cosines $\frac{3}{\sqrt{77}}, \frac{-2}{\sqrt{77}}, \frac{8}{\sqrt{77}}$ (1).

30. Corners A(0, 10), B(5, 5), C(15, 15), D(0, 20) (1½):



Z = 90, 60, 180, 180 (1). Minimum 60 at (5, 5); maximum 180 at every point of the segment CD (½).

31. P(E_1) = 0.6, P(E_2) = 0.4, P($A|E_1$) = 0.7, P($A|E_2$) = 0.3 (1). $P(E_2|A) = \frac{0.4\times0.3}{0.6\times0.7+0.4\times0.3}$ (1) $= \frac{0.12}{0.54} = \frac{2}{9}$ (1).

Section D

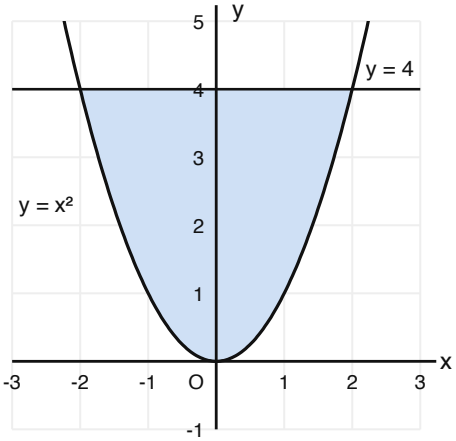
32. a ≤ a for every real a, so R is reflexive (1½). If a ≤ b and b ≤ c then a ≤ c, so R is transitive (1½). (1, 2) ∈ R but (2, 1) ∉ R, so R is not symmetric (2).

OR $3 - 4x_1 = 3 - 4x_2 \Rightarrow x_1 = x_2$, so f is one-one (2). For any real y, $x = \frac{3-y}{4}$ is real and f(x) = y (2), so f is onto (1).

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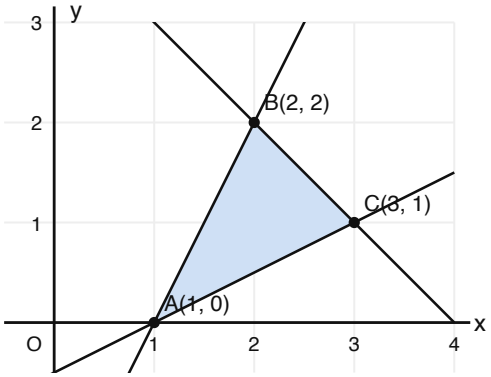
33. $A = \begin{bmatrix}4 & 3 & 2\\ 2 & 4 & 6\\ 6 & 2 & 3\end{bmatrix}$, $B = \begin{bmatrix}60\\ 90\\ 70\end{bmatrix}$, $|A| = 50$ (1). $\operatorname{adj} A = \begin{bmatrix}0 & -5 & 10\\ 30 & 0 & -20\\ -20 & 10 & 10\end{bmatrix}$ (2). $X = \frac{1}{50}\operatorname{adj} A \cdot B = \begin{bmatrix}5\\ 8\\ 8\end{bmatrix}$ (1½). Onions ₹5, wheat ₹8, rice ₹8 per kg (½).

34. They meet at x = ±2 (1). Figure (1):



Area $= \int_{-2}^{2}(4 - x^2)\,dx$ (1) $= \left[4x - \frac{x^3}{3}\right]_{-2}^{2} = \frac{32}{3}$ sq. units (2).

OR Figure (1):



AB: y = 2x – 2; BC: y = 4 – x; AC: $y = \frac{x-1}{2}$ (1). Area $= \int_1^2 (2x - 2)\,dx + \int_2^3 (4 - x)\,dx - \int_1^3 \frac{x-1}{2}\,dx$ (1) $= 1 + \frac{3}{2} - 1 = \frac{3}{2}$ sq. units (2).

35. Put $x^2 = t$ for the decomposition: $\frac{t}{(t+1)(t+4)} = \frac{-1/3}{t+1} + \frac{4/3}{t+4}$ (2). Integral $= -\frac{1}{3}\tan^{-1} x + \frac{4}{3}\cdot\frac{1}{2}\tan^{-1}\frac{x}{2} + C$ (2) $= -\frac{1}{3}\tan^{-1} x + \frac{2}{3}\tan^{-1}\frac{x}{2} + C$ (1).

Section E

36. (i) $V = \frac{4}{3}\pi r^3$.
(ii) $4\pi r^2 = 900\pi$ cm³/cm.
(iii) $\frac{dr}{dt} = \frac{900}{900\pi} = \frac{1}{\pi}$ cm/s. **OR** $\frac{dS}{dt} = 8\pi r\frac{dr}{dt} = 8\pi \times 15 \times \frac{1}{\pi} = 120$ cm²/s.

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37. (i) 0.6 × 0.9 = 0.54.

(ii) 0.54 + 0.4 × 0.8 = 0.86.

(iii) $\frac{0.54}{0.86} = \frac{27}{43}$. **OR** $\frac{0.4 \times 0.2}{0.14} = \frac{4}{7}$.

38. (i) $C(x) = \int (2x + 3)\, dx = x^2 + 3x + k$; C(0) = 50 gives $C(x) = x^2 + 3x + 50$.

(ii) C(10) = 100 + 30 + 50 = ₹180.

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