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Your JEE Guide

ISC Class XII · Mathematics

Sample Question Paper 3 · Session 2026-27

Time allowed: 3 hours (plus 15 minutes reading time) **Maximum marks: 80**

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This is an original practice paper written to the CISCE 2027 specimen paper format; it is not issued by CISCE.

General instructions:

1. You are allowed an additional fifteen minutes for only reading the question paper. You must NOT start writing during the reading time.
2. The paper consists of twenty questions and four sections: Sections A, B, C and D.
3. All questions are compulsory.
4. Section A consists of very short answer questions of 1 mark each. Section B consists of short answer questions of 2 marks each. Section C consists of moderately long answer questions of 3 marks each. Section D consists of long answer questions of 5 marks each.
5. Internal choices have been provided in three questions each in Sections B, C and D.
6. While attempting Multiple Choice Questions in Section A, you are required to write only ONE option as the answer.
7. The intended marks for questions or parts of questions are given in brackets [ ].
8. All workings, including rough work, should be done on the same page as, and adjacent to, the rest of the answer.

Section A (20 marks)

1.	**(i)** The number of reflexive relations on a set with 2 elements is: (a) 2 (b) 8 (c) 4 (d) 16	1
	(ii) If $f(x) = \frac{x-1}{x+2}$, x ≠ –2, then $f^{-1}(x)$ is: (a) $\frac{x+2}{x-1}$ (b) $\frac{1-2x}{1+x}$ (c) $\frac{2x-1}{x+1}$ (d) $\frac{1+2x}{1-x}$	1
	(iii) The principal value of $\sec^{-1}(-\sqrt{2})$ is: (a) $\frac{3\pi}{4}$ (b) $\frac{5\pi}{4}$ (c) $\frac{\pi}{4}$ (d) $-\frac{\pi}{4}$	1
	(iv) If $\sin^{-1} x = \frac{\pi}{5}$, then $\cos^{-1} x$ equals: (a) $\frac{7\pi}{10}$ (b) $\frac{3\pi}{10}$ (c) $\frac{4\pi}{5}$ (d) $\frac{\pi}{5}$	1

	(v) If A is a skew-symmetric matrix, then A^2 is: (a) an identity matrix (b) skew-symmetric (c) a null matrix (d) symmetric	1
	(vi) A is a square matrix of order 2 with |A| = 4. Then |–2A| is: (a) –8 (b) 8 (c) 16 (d) –16	1
	(vii) Statement I: f(x) = sin x is continuous at every real number. **Statement II:** g(x) = 1/x is continuous at x = 0. (a) Statement I is false and Statement II is true. (b) Statement I is true and Statement II is false. (c) Both the statements are true. (d) Both the statements are false.	1
	(viii) If $y = e^{x^2}$, then $\frac{dy}{dx}$ at x = 1 is: (a) 2e (b) e^2 (c) 2 (d) e	1
	(ix) The minimum value of $x + \frac{1}{x}$ for x > 0 is: (a) 0 (b) it has no minimum (c) 2 (d) 1	1
	(x) $\int \frac{dx}{e^x + e^{-x}}$ equals: (a) $\log(e^x + e^{-x}) + C$ (b) $\sin^{-1}(e^x) + C$ (c) $\tan^{-1}(e^{-x}) + C$ (d) $\tan^{-1}(e^x) + C$	1
	(xi) $\int_{-1}^{1} \frac{x^3}{1 + x^2}\, dx$ equals: (a) 0 (b) 2 (c) $\frac{\pi}{2}$ (d) 1	1
	(xii) The integrating factor of $\frac{dy}{dx} - y \tan x = 1$ is: (a) sin x (b) cos x (c) sec x (d) $e^{\tan x}$	1
	(xiii) The value of $\hat{i} \cdot (\hat{k} \times \hat{j})$ is: (a) –1 (b) 1 (c) 3 (d) 0	1
	(xiv) The angle between two lines with direction ratios 2, –1, 1 and 1, 1, –1 is: (a) 30° (b) 45° (c) 90° (d) 60°	1

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	(xv) A fair coin is tossed three times. The probability of getting exactly two heads is: (a) $\frac{1}{2}$ (b) $\frac{3}{8}$ (c) $\frac{1}{8}$ (d) $\frac{1}{4}$	1
	(xvi) Assertion: f(x) = log x is strictly increasing on (0, ∞). **Reason:** $f'(x) = \frac{1}{x} > 0$ for every x > 0. (a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. (b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. (c) Assertion is true and Reason is false. (d) Assertion is false and Reason is true.	1
	(xvii) Assertion: $(AB)' = A'B'$ for all square matrices A and B of the same order. **Reason:** $(AB)' = B'A'$. (a) Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. (b) Both Assertion and Reason are true, but Reason is not the correct explanation of Assertion. (c) Assertion is true and Reason is false. (d) Assertion is false and Reason is true.	1
	(xviii) If $\begin{bmatrix} x+y & 2 \\ 5 & xy \end{bmatrix} = \begin{bmatrix} 6 & 2 \\ 5 & 8 \end{bmatrix}$, find x and y.	1
	(xix) Find the rate of change of the volume of a sphere with respect to its radius r when r = 3 cm.	1
	(xx) Find λ if the line $\frac{x-1}{2} = \frac{y-2}{3} = \frac{z-3}{\lambda}$ is perpendicular to the plane 4x + 6y + 8z = 5.	1

Section B (14 marks)

2.	Show that f: $\mathbb{R} \to \mathbb{R}$, f(x) = 4x – 3 is invertible and find f^{-1}. **OR** Check whether the relation R = {(1, 2), (2, 1)} on the set {1, 2, 3} is reflexive, symmetric or transitive.	2
3.	Find the value of $\sin\left(2\tan^{-1}\frac{2}{3}\right)$.	2
4.	If $\sqrt{x} + \sqrt{y} = \sqrt{10}$, find $\frac{dy}{dx}$. **OR** Find $\frac{dy}{dx}$ if $y = \cos(\log x) + \log(\cos x)$, $0 < x < \frac{\pi}{2}$.	2
5.	The volume of a spherical balloon is increasing at 25 cm³/s. Find the rate at which its radius is increasing when the radius is 5 cm.	2

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6.	Find $\int \frac{dx}{1+\cos 2x}$. **OR** Find $\int \frac{x^3 - x^2 + x - 1}{x - 1}\, dx$.	2
7.	Find the Cartesian equation of the line through A(2, –1, 4) and B(3, 1, 0).	2
8.	For events A and B, P(A) = 0.8, P(B) = 0.5 and P(B | A) = 0.4. Find P(A | B) and P(A ∪ B).	2

Section C (21 marks)

9.	Solve for x: $\begin{vmatrix} x & 2 & 3 \\ 2 & x & 3 \\ 2 & 3 & x \end{vmatrix} = 0$. **OR** Show that $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$ satisfies $A^2 - 5A + 7I = O$, and hence find A^{-1}.	3
10.	Find a and b if $f(x) = \begin{cases} x^2 + 3x + a, & x \le 1 \\ bx + 2, & x > 1 \end{cases}$ is differentiable at x = 1.	3
11.	If $y^x = x^y$, find $\frac{dy}{dx}$.	3
12.	Find the point on the curve $y = x^2 - 4x + 5$ at which the tangent is parallel to the line y = 2x + 7. Write the equations of the tangent and the normal at that point. **OR** Find the intervals in which f(x) = sin x + cos x, 0 ≤ x ≤ 2π, is strictly increasing or strictly decreasing.	3
13.	Find $\int \frac{x^2}{(x^2+4)(x^2+9)}\, dx$.	3
14.	Evaluate $\int_{-1}^{2} \lvert x^3 - x \rvert\, dx$. **OR** Evaluate $\int_0^{\pi/2} \frac{\cos x}{(1+\sin x)(2+\sin x)}\, dx$.	3
15.	In a multiple-choice test with four options per question, a student knows the answer to a question with probability $\frac{2}{3}$ and otherwise guesses at random. Given that the student answered a question correctly, find the probability that the student knew the answer.	3

Section D (25 marks)

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16.	A student buys 2 pens, 3 notebooks and 1 geometry box for ₹230. Another buys 1 pen, 2 notebooks and 2 geometry boxes for ₹240, and a third buys 3 pens, 1 notebook and 1 geometry box for ₹170. Using the matrix method, find the price of each item.	5
17.	A farmer has 200 m of fencing to enclose a rectangular field along a straight river; no fence is needed along the river. (a) Find the dimensions that give the largest area, and that area. *[3]* (b) If the field must also be divided into two equal parts by a fence perpendicular to the river, find the new largest area. *[2]* **OR** Find $\int \frac{3x+5}{(x-1)^2(x+1)}\,dx$.	5
18.	Using integration, find the area of the region enclosed between the curves $y = x^2$ and $y = 4 - x^2$. **OR** Using integration, find the area of the region bounded by y = |x – 2| and the line y = 3.	5
19.	Solve the differential equation $(x+y)\frac{dy}{dx} = x - y$, given that y = 1 when x = 1.	5
20.	(a) Find the equation of the plane through A(1, 1, 0), B(1, 2, 1) and C(–2, 2, –1), and its distance from the origin. *[4]* (b) Find the sine of the angle between this plane and the line $\vec{r} = \lambda(\hat{i} + \hat{j} + \hat{k})$. *[1]* **OR** An urn contains 4 white and 6 red balls. Three balls are drawn at random without replacement. If X is the number of white balls drawn, find the probability distribution of X, its mean and its variance.	5

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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 (20 marks)

Question 1

(i) **(c)** 4. *Working:* Both pairs (a, a) must be present; each of the other 2 ordered pairs may or may not be, giving $2^2 = 4$.

(ii) **(d)** $\frac{1+2x}{1-x}$. *Working:* y(x + 2) = x − 1 gives x(1 − y) = 1 + 2y.

(iii) **(a)** $\frac{3\pi}{4}$. *Working:* The principal range of sec⁻¹ is [0, π] without $\frac{\pi}{2}$, and $\sec\frac{3\pi}{4} = -\sqrt{2}$.

(iv) **(b)** $\frac{3\pi}{10}$. *Working:* $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$.

(v) **(d)** symmetric. *Working:* $(A^2)' = (A')^2 = (-A)^2 = A^2$.

(vi) **(c)** 16. *Working:* $|-2A| = (-2)^2|A| = 16$.

(vii) **(b)** Statement I is true and Statement II is false. *Working:* sin x is continuous everywhere; 1/x is not even defined at x = 0.

(viii) **(a)** 2e. *Working:* $\frac{dy}{dx} = 2xe^{x^2} = 2e$ at x = 1.

(ix) **(c)** 2. *Working:* $1 - \frac{1}{x^2} = 0$ at x = 1, the second derivative $\frac{2}{x^3} > 0$, and the value there is 2.

(x) **(d)** $\tan^{-1}(e^x) + C$. *Working:* $\int \frac{e^x\,dx}{e^{2x}+1}$; put $t = e^x$.

(xi) **(a)** 0. *Working:* The integrand is an odd function.

(xii) **(b)** cos x. *Working:* $e^{-\int \tan x\,dx} = e^{\log\cos x} = \cos x$.

(xiii) **(a)** –1. *Working:* $\hat{k}\times\hat{j} = -\hat{i}$.

(xiv) **(c)** 90°. *Working:* 2(1) + (–1)(1) + 1(–1) = 0, so the lines are perpendicular.

(xv) **(b)** $\frac{3}{8}$. *Working:* HHT, HTH and THH: 3 of 8 equally likely outcomes.

(xvi) **(a)** Both Assertion and Reason are true, and Reason is the correct explanation of Assertion. *Working:* A positive derivative throughout an interval is exactly what makes f strictly increasing there.

(xvii) **(d)** Assertion is false and Reason is true. *Working:* The Reason is the reversal law for transposes, which is true; since matrix products do not commute in general, the Assertion is false.

(xviii) x + y = 6 and xy = 8 (½), so (x, y) = (2, 4) or (4, 2) (½).

(xix) $\frac{dV}{dr} = 4\pi r^2$ (½) $= 36\pi$ cm³ per cm (½).

(xx) The line must be parallel to the normal (4, 6, 8): $\frac{2}{4} = \frac{3}{6} = \frac{\lambda}{8}$ (½), so λ = 4 (½).

Section B (14 marks)

2. f(a) = f(b) ⇒ a = b, and for any real y, x = (y + 3)/4 gives f(x) = y; so f is a bijection and invertible (1). $f^{-1}(x) = \frac{x+3}{4}$ (1).

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OR (1, 1) $\notin$ R, so not reflexive (½). Each pair's reverse is in R, so symmetric (½). (1, 2), (2, 1) $\in$ R but (1, 1) $\notin$ R, so not transitive (1).

3. Let $\tan\theta = \frac{2}{3}$. $\sin 2\theta = \frac{2\tan\theta}{1+\tan^2\theta}$ (1) $= \frac{4/3}{13/9} = \frac{12}{13}$ (1).

4. $\frac{1}{2\sqrt{x}} + \frac{1}{2\sqrt{y}}\frac{dy}{dx} = 0$ (1), so $\frac{dy}{dx} = -\sqrt{\frac{y}{x}}$ (1).

OR $\frac{dy}{dx} = -\frac{\sin(\log x)}{x}$ (1) $-\tan x$ (1).

5. $\frac{dV}{dt} = 4\pi r^2\frac{dr}{dt}$ (1), so $25 = 100\pi\frac{dr}{dt}$ and $\frac{dr}{dt} = \frac{1}{4\pi}$ cm/s (1).

6. $1 + \cos 2x = 2\cos^2 x$ (1), so the integral is $\frac{1}{2}\int \sec^2 x\,dx = \frac{1}{2}\tan x + C$ (1).

OR $x^3 - x^2 + x - 1 = (x-1)(x^2+1)$ (1), so the integral is $\frac{x^3}{3} + x + C$ (1).

7. Direction ratios of AB: 1, 2, –4 (1). $\frac{x-2}{1} = \frac{y+1}{2} = \frac{z-4}{-4}$ (1).

8. P(A ∩ B) = 0.8 × 0.4 = 0.32; P(A | B) = 0.32/0.5 = 0.64 (1). P(A ∪ B) = 0.8 + 0.5 − 0.32 = 0.98 (1).

Section C (21 marks)

9. $C_1 \to C_1 + C_2 + C_3$ takes out (x + 5): $(x+5)\begin{vmatrix}1 & 2 & 3\\ 1 & x & 3\\ 1 & 3 & x\end{vmatrix}$ (1). $R_2 - R_1$, $R_3 - R_1$ give $(x+5)(x-2)(x-3)$ (1). So x = –5, 2 or 3 (1).

OR $A^2 = \begin{bmatrix}8 & 5\\ -5 & 3\end{bmatrix}$ and $5A = \begin{bmatrix}15 & 5\\ -5 & 10\end{bmatrix}$, so $A^2 - 5A + 7I = O$ (1½). Multiplying by A^{-1}: $A - 5I + 7A^{-1} = O$, so $A^{-1} = \frac{1}{7}(5I - A) = \frac{1}{7}\begin{bmatrix}2 & -1\\ 1 & 3\end{bmatrix}$ (1½).

10. Continuity at 1: 4 + a = b + 2 (1). Equal one-sided derivatives: 2(1) + 3 = b, so b = 5 (1). Then a = 3 (1).

11. x log y = y log x (½). $\log y + \frac{x}{y}\frac{dy}{dx} = \frac{dy}{dx}\log x + \frac{y}{x}$ (1). $\frac{dy}{dx} = \frac{\frac{y}{x} - \log y}{\frac{x}{y} - \log x} = \frac{y(y - x\log y)}{x(x - y\log x)}$ (1½).

12. 2x – 4 = 2, x = 3, y = 2: the point is (3, 2) (1). Tangent: y = 2x – 4 (1). Normal: $y - 2 = -\frac{1}{2}(x-3)$, i.e. x + 2y = 7 (1).

OR f′(x) = cos x – sin x = 0 at $x = \frac{\pi}{4}, \frac{5\pi}{4}$ (1). f′ > 0 on $\left[0, \frac{\pi}{4}\right)$ and $\left(\frac{5\pi}{4}, 2\pi\right]$: increasing there (1). f′ < 0 on $\left(\frac{\pi}{4}, \frac{5\pi}{4}\right)$: decreasing (1).

13. With $t = x^2$: $\frac{t}{(t+4)(t+9)} = -\frac{4/5}{t+4} + \frac{9/5}{t+9}$ (1½). Integral $= -\frac{2}{5}\tan^{-1}\frac{x}{2} + \frac{3}{5}\tan^{-1}\frac{x}{3} + C$ (1½).

14. $x^3 - x \geq 0$ on [–1, 0] and [1, 2], ≤ 0 on [0, 1] (1). $\int_{-1}^{0}(x^3 - x)dx + \int_0^1(x - x^3)dx + \int_1^2(x^3 - x)dx = \frac{1}{4} + \frac{1}{4} + \frac{9}{4}$ (1½) $= \frac{11}{4}$ (½).

OR Put t = sin x: $\int_0^1 \frac{dt}{(1+t)(2+t)} = \int_0^1\left(\frac{1}{1+t} - \frac{1}{2+t}\right)dt$ (1½) $= \left[\log\frac{1+t}{2+t}\right]_0^1 = \log\frac{2}{3} - \log\frac{1}{2} = \log\frac{4}{3}$ (1½).

15. P(correct) $= \frac{2}{3}\times 1 + \frac{1}{3}\times\frac{1}{4} = \frac{3}{4}$ (1½). P(knew | correct) $= \frac{2/3}{3/4} = \frac{8}{9}$ (1½).

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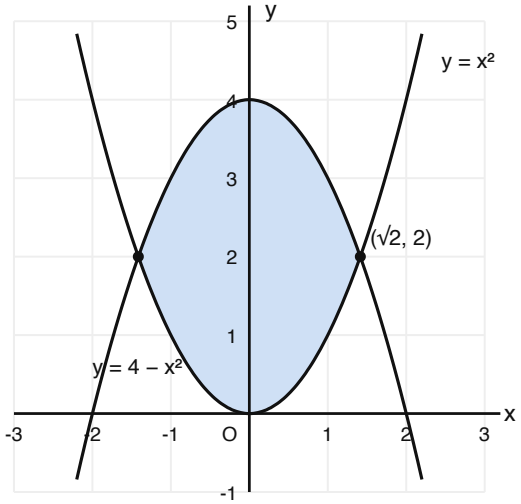
Section D (25 marks)

16. With prices p, n, b: $A = \begin{bmatrix} 2 & 3 & 1 \\ 1 & 2 & 2 \\ 3 & 1 & 1 \end{bmatrix}$, B = (230, 240, 170), |A| = 2(0) − 3(−5) + 1(−5) = 10 (1). $\operatorname{adj} A = \begin{bmatrix} 0 & -2 & 4 \\ 5 & -1 & -3 \\ -5 & 7 & 1 \end{bmatrix}$ (2). $X = \frac{1}{10}\begin{bmatrix} 0 & -2 & 4 \\ 5 & -1 & -3 \\ -5 & 7 & 1 \end{bmatrix}\begin{bmatrix} 230 \\ 240 \\ 170 \end{bmatrix} = \frac{1}{10}\begin{bmatrix} 200 \\ 400 \\ 700 \end{bmatrix}$ (1). A pen costs ₹20, a notebook ₹40 and a geometry box ₹70 (1).

17. (a) Sides x (perpendicular to the river) and 200 − 2x: A = x(200 − 2x) (1). A′ = 200 − 4x = 0, x = 50; A″ = −4 < 0 (1). The field is 50 m by 100 m, area 5000 m² (1). (b) A = x(200 − 3x), A′ = 200 − 6x = 0, x = 100/3, A″ < 0 (1); area $= \frac{100}{3} \times 100 = \frac{10000}{3}$ m² (1).

OR $\frac{3x+5}{(x-1)^2(x+1)} = \frac{A}{x-1} + \frac{B}{(x-1)^2} + \frac{C}{x+1}$ (1). x = 1 gives B = 4; x = −1 gives $C = \frac{1}{2}$; comparing x² terms, $A = -\frac{1}{2}$ (2). Integral $= -\frac{1}{2}\log|x-1| - \frac{4}{x-1} + \frac{1}{2}\log|x+1| + C$ (2).

18. They meet where $x^2 = 2$, $x = \pm\sqrt{2}$ (1). Sketch (1):



Area $= \int_{-\sqrt{2}}^{\sqrt{2}} (4 - 2x^2)\,dx$ (1) $= 2\left[4x - \frac{2x^3}{3}\right]_0^{\sqrt{2}} = 2\left(4\sqrt{2} - \frac{4\sqrt{2}}{3}\right) = \frac{16\sqrt{2}}{3}$ square units (2).

OR |x − 2| = 3 at x = −1 and x = 5 (1). Area $= \int_{-1}^{5} (3 - |x-2|)\,dx$ (1) $= 18 - \left(\int_{-1}^{2}(2-x)dx + \int_{2}^{5}(x-2)dx\right)$ (1) $= 18 - \left(\frac{9}{2} + \frac{9}{2}\right) = 9$ square units (2).

19. $\frac{dy}{dx} = \frac{1 - y/x}{1 + y/x}$: homogeneous; put y = vx (1). $x\frac{dv}{dx} = \frac{1 - 2v - v^2}{1+v}$ (1). $\int \frac{(1+v)\,dv}{1-2v-v^2} = \int \frac{dx}{x}$ gives $-\frac{1}{2}\log|1 - 2v - v^2| = \log|x| + c$, i.e. $x^2(1 - 2v - v^2) = C$ (1½). So $x^2 - 2xy - y^2 = C$; y(1) = 1 gives C = −2: $y^2 + 2xy - x^2 = 2$ (1½).

20. (a) $\overrightarrow{AB} = (0, 1, 1)$, $\overrightarrow{AC} = (-3, 1, -1)$; normal $= \overrightarrow{AB} \times \overrightarrow{AC} = (-2, -3, 3)$ (2). Plane: −2(x − 1) − 3(y − 1) + 3z = 0, i.e. 2x + 3y − 3z = 5 (1). Distance from O $= \frac{5}{\sqrt{22}}$ (1). (b) $\sin\phi = \frac{|2+3-3|}{\sqrt{22}\sqrt{3}} = \frac{2}{\sqrt{66}}$ (1).

OR $\binom{10}{3} = 120$. P(X = 0) = 20/120, P(X = 1) = 4 × 15/120 = 60/120, P(X = 2) = 6 × 6/120 = 36/120, P(X = 3) = 4/120 (2). Mean $= \frac{60+72+12}{120} = \frac{6}{5}$ (1). $E(X^2) = \frac{60+144+36}{120} = 2$, variance $= 2 -$

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$\frac{36}{25} = \frac{14}{25}$ (2).

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