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Your JEE Guide

MP Board Class XII · Higher Mathematics

Sample Question Paper 1 · Session 2026-27

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

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This is an original practice paper written to the MPBSE 2027 sample question paper pattern; it is not issued by MPBSE.

General instructions:

1. All questions are compulsory.
2. Sub-questions of question numbers 1 to 5 carry 1 mark each.
3. Question numbers 6 to 15 carry 2 marks each.
4. Question numbers 16 to 19 carry 3 marks each.
5. Question numbers 20 to 23 carry 4 marks each.
6. Internal choices are provided for question numbers 16 to 23.
7. Draw neat and clean labelled diagrams wherever required.

1.	**(i)** *Choose and write the correct option:* If f(x) = 2x + 3, then $f^{-1}(x)$ is: (a) $\frac{1}{2x+3}$ (b) $2x - 3$ (c) $\frac{x-3}{2}$ (d) $\frac{x+3}{2}$	1
	(ii) The principal value of $\cos^{-1}(-1)$ is: (a) 0 (b) π (c) $\frac{\pi}{2}$ (d) $-\pi$	1
	(iii) If A is a 2 × 3 matrix and B is a 3 × 4 matrix, the order of AB is: (a) 4 × 2 (b) 3 × 3 (c) AB is not defined (d) 2 × 4	1
	(iv) For x > 0, $\frac{d}{dx}\log(x^2)$ equals: (a) $\frac{2}{x}$ (b) $\frac{1}{x^2}$ (c) $\frac{1}{x}$ (d) $2x$	1
	(v) $\int_0^1 e^x\,dx$ equals: (a) 1 (b) e (c) e + 1 (d) e – 1	1
	(vi) The degree of the differential equation $\left(\frac{d^2y}{dx^2}\right)^2 + \frac{dy}{dx} = 0$ is: (a) 2 (b) not defined (c) 1 (d) 0	1

2.	**(i)** *Fill in the blanks:* A function that is both one-one and onto is called _____.	1
	(ii) The range of the principal value branch of $\sin^{-1} x$ is _____.	1
	(iii) A square matrix A for which A′ = A is called a _____ matrix.	1
	(iv) The derivative of tan x is _____.	1
	(v) $\int \frac{dx}{x}$ = _____.	1
	(vi) Two non-zero vectors are perpendicular if their scalar product is _____.	1
3.	**(i)** *Write True or False:* Every relation that is reflexive and symmetric is also transitive.	1
	(ii) $\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$ for every x in [–1, 1].	1
	(iii) Multiplication of matrices is commutative.	1
	(iv) Every differentiable function is continuous.	1
	(v) If f is an even function, then $\int_{-a}^{a} f(x)\,dx = 0$.	1
	(vi) The direction cosines of the x-axis are 1, 0, 0.	1
4.	Match column A with column B:	7

Column A	Column B
(i) $\frac{d}{dx} e^x$	(a) sin x + C
(ii) $\frac{d}{dx} \log x$	(b) tan x + C
(iii) $\int \cos x\,dx$	(c) 1
(iv) $\int \sec^2 x\,dx$	(d) $\frac{1}{x}$
(v) $\frac{d}{dx} \sin^{-1} x$	(e) e^x
(vi) $\hat{i} \cdot \hat{i}$	(f) $\hat{k}$
(vii) $\hat{i} \times \hat{j}$	(g) $\frac{1}{\sqrt{1-x^2}}$

5.	**(i)** *Write the answer in one word or one sentence:* If $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, write |A|.	1
	(ii) Write the value of $\sin\left(\cos^{-1} 1\right)$.	1
	(iii) If $y = x^5$, write $\frac{dy}{dx}$.	1
	(iv) Write the order of the differential equation $\frac{dy}{dx} + y = 0$.	1

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	(v) Write the magnitude of the vector $2\hat{i} - 3\hat{j} + 6\hat{k}$.	1
	(vi) If P(A) = 0.3, write P(not A).	1
	(vii) How many corner points does the feasible region x ≥ 0, y ≥ 0, x + y ≤ 4 have?	1
6.	Show that the function f: $\mathbb{R} \to \mathbb{R}$, f(x) = 5x – 2 is one-one.	2
7.	Find the value of $\sin^{-1}\frac{\sqrt{3}}{2} + \cos^{-1}\left(-\frac{1}{2}\right)$.	2
8.	If $A = \begin{bmatrix} 2 & 3 \\ 1 & 4 \end{bmatrix}$, find A + A′ and show that it is symmetric.	2
9.	Evaluate $\begin{vmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{vmatrix}$.	2
10.	Find $\frac{dy}{dx}$ if $y = e^x \log x$.	2
11.	Find the slope of the tangent to the curve $y = x^3 - x$ at x = 2.	2
12.	Find $\int \left(x^2 + \frac{1}{x}\right) dx$.	2
13.	Evaluate $\int_0^{\pi/2} \cos x \, dx$.	2
14.	Find $\vec{a} \cdot \vec{b}$ if $\vec{a} = 2\hat{i} + \hat{j} - \hat{k}$ and $\vec{b} = \hat{i} - 3\hat{j} + 2\hat{k}$.	2
15.	Two coins are tossed together. Find the probability of getting at least one head.	2
16.	Show that the relation R on $\mathbb{Z}$ given by aRb if and only if a – b is even is an equivalence relation. **OR** Using the adjoint, find the inverse of $A = \begin{bmatrix} 2 & 5 \\ 1 & 3 \end{bmatrix}$.	3
17.	Find the value of k for which $f(x) = \begin{cases} kx + 1, & x \le 5 \\ 3x - 5, & x > 5 \end{cases}$ is continuous at x = 5. **OR** If x = a cos t and y = b sin t, find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$.	3
18.	Find $\int x \sin x \, dx$. **OR** Find $\int \frac{dx}{x^2 + 2x + 2}$.	3

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19.	Bag I contains 3 red and 2 black balls; bag II contains 2 red and 4 black balls. A bag is chosen at random and a ball drawn from it is red. Find the probability that it came from bag I. **OR** P(A) = 0.5, P(B) = 0.3 and P(A ∩ B) = 0.15. Find P(A | B) and P(B | A). Are A and B independent?	3
20.	Solve by the matrix method: x + y + z = 3, 2x − y + z = 2, x + 2y − z = 2. **OR** For $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$, show that $A^2 - 2A - 3I = O$. Hence find A^{-1}.	4
21.	Find the points of local maximum and local minimum of $f(x) = x^3 - 3x + 2$, and the local maximum and minimum values. **OR** Show that, of all rectangles inscribed in a circle of radius r, the square has the greatest area.	4
22.	Using integration, find the area enclosed by the ellipse $\frac{x^2}{25} + \frac{y^2}{4} = 1$. **OR** (a) Find $\int \frac{dx}{(x-1)(x+2)}$. *[2]* (b) Find $\int \log x \, dx$. *[2]*	4
23.	Solve the following linear programming problem graphically: Maximise Z = 5x + 4y subject to x + y ≤ 6, 2x + y ≤ 10, x ≥ 0, y ≥ 0. **OR** Solve the differential equation $\frac{dy}{dx} - \frac{y}{x} = 2x^2$, x > 0.	4

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Answers and Marking Scheme

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

Question 1

(i) **(c)** $\frac{x-3}{2}$. *Working:* y = 2x + 3 gives x = (y − 3)/2.

(ii) **(b)** π. *Working:* cos π = −1, and π lies in [0, π].

(iii) **(d)** 2 × 4. *Working:* (2 × 3)(3 × 4) gives 2 × 4.

(iv) **(a)** $\frac{2}{x}$. *Working:* log x² = 2 log x.

(v) **(d)** e − 1. *Working:* $\left[e^{x}\right]_{0}^{1}$.

(vi) **(a)** 2. *Working:* The highest-order derivative appears squared.

Question 2

(i) bijective (a bijection).

(ii) $\left[-\frac{\pi}{2}, \frac{\pi}{2}\right]$.

(iii) symmetric.

(iv) sec²x.

(v) log|x| + C.

(vi) zero.

Question 3

(i) False.

(ii) True.

(iii) False: in general AB ≠ BA.

(iv) True.

(v) False: that holds for odd functions; for even functions it equals $2\int_{0}^{a} f(x)\,dx$.

(vi) True.

4. (i) – (e) e^{x}; (ii) – (d) $\frac{1}{x}$; (iii) – (a) sin x + C; (iv) – (b) tan x + C; (v) – (g) $\frac{1}{\sqrt{1-x^{2}}}$; (vi) – (c) 1; (vii) – (f) $\hat{k}$

Question 5

(i) −2.

(ii) 0.

(iii) $5x^{4}$.

(iv) 1.

(v) 7.

(vi) 0.7.

(vii) 3: (0, 0), (4, 0) and (0, 4).

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6. Let f(a) = f(b): 5a – 2 = 5b – 2 (1), so a = b; hence f is one-one (1).

7. $\frac{\pi}{3} + \frac{2\pi}{3}$ (1) $= \pi$ (1).

8. $A + A' = \begin{bmatrix} 4 & 4 \\ 4 & 8 \end{bmatrix}$ (1). It equals its own transpose, so it is symmetric (1).

9. $\cos^2\theta + \sin^2\theta$ (1) = 1 (1).

10. Product rule: $e^x \log x + e^x \cdot \frac{1}{x}$ (1) $= e^x \left(\log x + \frac{1}{x}\right)$ (1).

11. $\frac{dy}{dx} = 3x^2 - 1$ (1) = 11 at x = 2 (1).

12. $\frac{x^3}{3} + \log|x| + C$ (1 + 1).

13. $[\sin x]_0^{\pi/2}$ (1) = 1 (1).

14. 2(1) + 1(–3) + (–1)(2) (1) = –3 (1).

15. Outcomes HH, HT, TH, TT (1); three favourable, so P = 3/4 (1).

16. Reflexive: a – a = 0 is even (1). Symmetric: if a – b is even, so is b – a (1). Transitive: if a – b and b – c are even, their sum a – c is even (1).

OR |A| = 6 – 5 = 1 (1). $\operatorname{adj} A = \begin{bmatrix} 3 & -5 \\ -1 & 2 \end{bmatrix}$ (1). $A^{-1} = \operatorname{adj} A / |A| = \begin{bmatrix} 3 & -5 \\ -1 & 2 \end{bmatrix}$ (1).

17. Left-hand limit and f(5): 5k + 1 (1). Right-hand limit: 15 – 5 = 10 (1). 5k + 1 = 10, so $k = \frac{9}{5}$ (1).

OR $\frac{dy}{dx} = \frac{b\cos t}{-a\sin t} = -\frac{b}{a}\cot t$ (1½). $\frac{d^2y}{dx^2} = \frac{\frac{b}{a}\csc^2 t}{-a\sin t} = -\frac{b}{a^2}\csc^3 t$ (1½).

18. By parts with u = x, dv = sin x dx (1): $-x\cos x + \int \cos x\, dx$ (1) $= -x\cos x + \sin x + C$ (1).

OR $x^2 + 2x + 2 = (x+1)^2 + 1$ (1½). Integral $= \tan^{-1}(x+1) + C$ (1½).

19. P(red | I) = 3/5, P(red | II) = 1/3 (1). By Bayes' theorem, P(I | red) = $\frac{\frac{1}{2}\cdot\frac{3}{5}}{\frac{1}{2}\cdot\frac{3}{5} + \frac{1}{2}\cdot\frac{1}{3}}$ (1) $= \frac{9}{14}$ (1).

OR P(A | B) = 0.15/0.3 = 0.5 (1). P(B | A) = 0.15/0.5 = 0.3 (1). P(A ∩ B) = P(A)P(B), so they are independent (1).

20. $A = \begin{bmatrix} 1 & 1 & 1 \\ 2 & -1 & 1 \\ 1 & 2 & -1 \end{bmatrix}$, |A| = 1(–1) – 1(–3) + 1(5) = 7 (1). $\operatorname{adj} A = \begin{bmatrix} -1 & 3 & 2 \\ 3 & -2 & 1 \\ 5 & -1 & -3 \end{bmatrix}$ (1½).

$X = \frac{1}{7}\begin{bmatrix} -1 & 3 & 2 \\ 3 & -2 & 1 \\ 5 & -1 & -3 \end{bmatrix}\begin{bmatrix} 3 \\ 2 \\ 2 \end{bmatrix} = \frac{1}{7}\begin{bmatrix} 7 \\ 7 \\ 7 \end{bmatrix}$ (1), so x = 1, y = 1, z = 1 (½).

OR $A^2 = \begin{bmatrix} 5 & 4 \\ 4 & 5 \end{bmatrix}$ (1). $A^2 - 2A - 3I = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} = O$ (1). Multiplying by A^{-1}: $A - 2I - 3A^{-1} = O$ (1), so $A^{-1} = \frac{1}{3}(A - 2I) = \frac{1}{3}\begin{bmatrix} -1 & 2 \\ 2 & -1 \end{bmatrix}$ (1).

21. $f'(x) = 3x^2 - 3 = 0$ at x = ±1 (1). f″(x) = 6x: f″(–1) = –6 < 0 and f″(1) = 6 > 0 (1). Local maximum at x = –1, value f(–1) = 4 (1). Local minimum at x = 1, value f(1) = 0 (1).

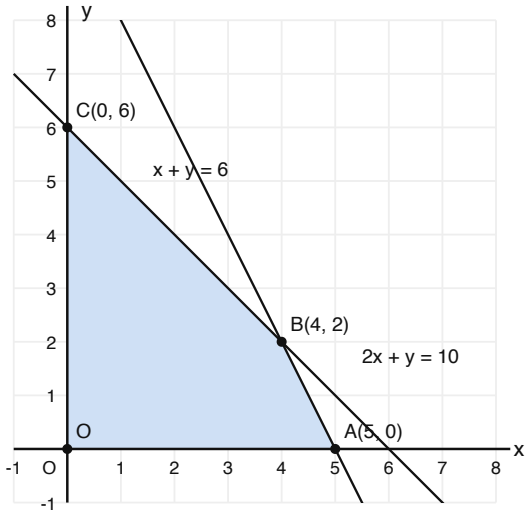
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OR With sides 2r cos θ and 2r sin θ, the area is A = 4r² sin θ cos θ = 2r² sin 2θ (1½). dA/dθ = 4r² cos 2θ = 0 at θ = π/4 (1). d²A/dθ² = −8r² sin 2θ < 0 there, so A is greatest (½). At θ = π/4 the sides are equal: a square (1).

22. By symmetry, area = 4 × area in the first quadrant, where $y = \frac{2}{5}\sqrt{25 - x^2}$ (1). Area $= 4\int_0^5 \frac{2}{5}\sqrt{25 - x^2}\,dx$ (1) $= \frac{8}{5}\left[\frac{x}{2}\sqrt{25 - x^2} + \frac{25}{2}\sin^{-1}\frac{x}{5}\right]_0^5 = \frac{8}{5}\cdot\frac{25\pi}{4}$ (1) = 10π square units (1).

OR (a) $\frac{1}{(x-1)(x+2)} = \frac{1}{3}\left(\frac{1}{x-1} - \frac{1}{x+2}\right)$ (1); integral $= \frac{1}{3}\log\left|\frac{x-1}{x+2}\right| + C$ (1). (b) By parts: $x\log x - \int x\cdot\frac{1}{x}\,dx$ (1) $= x\log x - x + C$ (1).

23. Feasible region OABC (1½):



The lines meet at B(4, 2) (½). Z(O) = 0, Z(A) = 25, Z(B) = 28, Z(C) = 24 (1). Maximum Z = 28 at x = 4, y = 2 (1).

OR It is linear with P = −1/x; IF $= e^{-\log x} = \frac{1}{x}$ (1½). $\frac{y}{x} = \int 2x^2\cdot\frac{1}{x}\,dx = x^2 + C$ (1½). $y = x^3 + Cx$ (1).

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