SET II

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MID EXAMINATION (2025-26)

CLASS: XII

MATHEMATICS

TIME ALLOWED: 3 HOURS **MAXIMUM MARKS: 80**

General Instructions:

1. This Question paper contains - five sections A, B, C, D and E. Each section is compulsory. However, there are internal choices in some questions.
2. **Section A** has **18 MCQ's** and **02 Assertion-Reason based questions** of 1 mark each.
3. **Section B** has **5 Very Short Answer (VSA)**-type questions of 2 marks each.
4. **Section C** has **6 Short Answer (SA)**-type questions of 3 marks each.
5. **Section D** has **4 Long Answer (LA)**-type questions of 5 marks each.
6. **Section E** has **3 source based/case based/passage based/integrated units of assessment** of 4 marks each with sub-parts.

SECTION – A

(All questions are compulsory. No internal choice is provided in this section)

Q1 If $A = [a_{ij}]$ is a skew-symmetric matrix of order n, then 1

(a) $a_{ij} = \frac{1}{a_{ji}}, \forall i,j$ (b) $a_{ij} \neq 0, \forall i,j$ (c) $a_{ij} = 0, where\ i = j$ (d) $a_{ij} \neq 0, where\ i = j$

Q2 The area enclosed by the circle $x^2 + y^2 = 8$ is 1

(a) 16π sq. units (b) $2\sqrt{2}\pi$ sq. units (c) $8\pi^2$ sq. units (d) 8π sq. units

Q3 If $x\begin{bmatrix}2\\3\end{bmatrix} + y\begin{bmatrix}-1\\1\end{bmatrix} = \begin{bmatrix}10\\5\end{bmatrix}$, find the value of x 1

(a) 1 (b) 2 (c) 3 (d) 4

Q4 If $y = log_e\left(\frac{x^2}{e^2}\right)$, then $\frac{d^2y}{dx^2}$ equals to 1

(a) $-\frac{1}{x}$ (b) $-\frac{1}{x^2}$ (c) $\frac{2}{x^2}$ (d) $-\frac{2}{x^2}$

Q5 The value of k for which the function $f(x) = \begin{cases} \frac{1-cos4x}{8x^2}, & if\ x \neq 0 \\ k, & if\ x = 0 \end{cases}$ is continuous at $x = 0$ is 1

(a) 0 (b) -1 (c) 1 (d) 2

Q6 If $f'(x) = x + \frac{1}{x}$, then $f(x)$ is 1

(a) $x^2 + logx + c$ (b) $\frac{x^2}{2} + logx + c$ (c) $\frac{x}{2} + logx + c$ (d) $\frac{x}{2} - logx + c$

Q7 If $y = sin^{-1}x$, then $(1 - x^2)y_2$ is equal to 1

(a) xy_1 (b) xy (c) xy_2 (d) x^2

Q8 If $\int_0^1 (3x^2 + 2x + k)dx = 0$, then find the value of k 1

(a) 1 (b) 2 (c) -2 (d) 3

Q9 The value of $\int_{-1}^{1}(x - [x])dx$ is 1

(a) -1 (b) 0 (c) 1 (d) 2

Q10 The value of $\int_2^3 \frac{x}{x^2+1}dx$ is 1

(a) log4 (b) $\log\frac{3}{2}$ (c) $\frac{1}{2}\log 2$ (d) $2\log\frac{3}{2}$

Q11 For the matrix $X = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$, $(X^2 - X)$ is 1

(a) 2I (b) 3I (c) I (d) 5I

Q12 $\int cos^3x.e^{\log(sinx)}dx$ is equal to 1

(a) $-\frac{cos^4x}{4} + c$ (b) $-\frac{sin^4x}{4} + c$ (c) $\frac{e^{sinx}}{4} + c$ (d) none of these

Q13 If $\Delta = \begin{vmatrix} 5 & 3 & 8 \\ 2 & 0 & 1 \\ 1 & 2 & 3 \end{vmatrix}$, then the cofactor of element a_{32} is 1

(a) 11 (b) -11 (c) -4 (d)4

Q14 If $\begin{vmatrix} x & 2 \\ 18 & x \end{vmatrix} = \begin{vmatrix} 6 & 2 \\ 18 & 6 \end{vmatrix}$, then x is equal to 1

(a) 6 (b) ± 6 (c) -6 (d) 0

Q15 The area of the region bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ is 1

(a) $20\pi^2$ sq. units (b) 25π sq. units (c) 20π sq. units (d) $16\pi^2$ sq. units

Q16 If A and B are two matrices of the order 3 x m and 3 x n respectively and m = n, then the order of matrix (5A- 2B) is 1

(a) m x 3 (b) 3 x 3 (c) m x n (d) 3 x n

Q17 If A is a square matrix of order 3 and $|-5A| = k|A|$, then the value of k 1

(a) -125 (b) 125 (c) -25 (d) 25

Q18 For any matrix $A = [a_{ij}]$, if c_{ij} denotes its cofactors then find the value of $a_{11}c_{12} + a_{12}c_{22} + a_{13}c_{32}$ 1

(a) 1 (b) 0 (c) -1 (d) none of these

Questions numbers 19 and 20 are Assertion and Reason based questions. Two statements are given, one labelled Assertion(A) and the other labelled Reason (R). Select the correct answer from the codes (a), (b), (c) and (d) as given below:

(a) Both Assertion(A) and Reason(R) are true and Reason (R) is the correct explanation of the Assertion(A).

(b) Both Assertion(A) and Reason(R) are true but Reason (R) is not the correct explanation of the Assertion(A).

(c) Assertion(A) is true but Reason (R) is false.

(d) Assertion(A) is false but Reason (R) is true.

Q19 **Assertion (A):** A function $f: N \to N$ be defined by:

$$f(n) = \begin{cases} \frac{n+1}{2}, & if\ n\ is\ odd \\ \frac{n}{2}, & if\ n\ is\ even \end{cases} \quad \forall n \in N \text{ is one - one}$$ 1

Reason (R) : A function $f: A \to B$ is said to be injective if $f(a) = f(b) \Rightarrow a = b$

Q20 **Assertion (A):** The principal value of $\tan^{-1}\left(\tan\frac{7\pi}{6}\right) = \frac{\pi}{6}$. 1

Reason (R) : $f(x) = tan^{-1}x\ , x \in \left(-\frac{\pi}{2}, \frac{\pi}{2}\right)$

SECTION – B

(All questions are compulsory. In case of internal choice, attempt any one question only)

Q21 Write the principal value of :- $4\tan^{-1}(1) + \cos^{-1}\left(-\frac{1}{2}\right)$

OR

If $\sin[\cot^{-1}(x+1)] = \cos(tan^{-1}x)$, then find the value of x. 2

Q22 For the curve $y = 5x - 2x^3$, if x increases at the rate of 2 units/sec, then how fast is the slope of the curve changing when $x = 2$. 2

Q23 Find the value of a , b, c and d from the equation: $\begin{bmatrix} a-b & 2a+c \\ 2a-b & 3c+d \end{bmatrix} = \begin{bmatrix} -1 & 5 \\ 0 & 13 \end{bmatrix}$

OR

If $F(x) = \begin{bmatrix} cosx & -sinx & 0 \\ sinx & cosx & 0 \\ 0 & 0 & 1 \end{bmatrix}$, show that $F(x)F(y) = F(x+y)$ 2

Q24 If $y = (\tan^{-1}x)^2$, show that $(x^2+1)^2 \cdot \frac{d^2y}{dx^2} + 2x(x^2+1)\frac{dy}{dx} = 2$ 2

Q25 Check whether the relation R in the set Z of integers defined as $R = \{(a,b): a + b\ is\ divisible\ by\ 2\}$ is reflexive and transitive or not. 2

SECTION – C

(All questions are compulsory. In case of internal choice, attempt any one question only)

Q26 Find $\int \frac{dx}{\sqrt{3-2x-x^2}}$ 3

Q27 Find $\frac{dy}{dx}$ if $y^x + x^y + x^x = a^b$ 3

Q28 Evaluate: $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} e^x \left(\frac{1-sinx}{1-cosx}\right) dx$

OR 3

Evaluate: $\int_0^1 x\,(1-x)^n dx$

Q29 Find the values of k so that the function f, $f(x) = \begin{cases} \frac{x^2-2x-3}{x+1}, & if\ x \neq -1 \\ k, & if\ x = -1 \end{cases}$ is continuous at $x = -1$ 3

OR

Check the differentiability of function $f(x) = x|x|$ at $x = 0$. 3

Q30 Show that the function $f(x) = \frac{16sinx}{4+cosx} - x$, is strictly decreasing in $\left(\frac{\pi}{2}, \pi\right)$ 3

Q31 Evaluate : $\int \frac{3x+1}{(x-1)^2(x+3)}dx$ 3

OR

Evaluate : $\int e^x \left(\frac{sin4x-4}{1-cos4x}\right)dx$

SECTION – D

(All questions are compulsory. In case of internal choice, attempt any one question only)

Q32 Evaluate $\int \frac{cosx}{(4+sin^2x)(5-4cos^2x)}dx$ 5

Q33 Using integration, find the area bounded by the lines $x + 2y = 2$, $y - x = 1$ *and* $2x + y = 7$ 5

Q34 Use the product $\begin{bmatrix}1 & -1 & 2\\ 0 & 2 & -3\\ 3 & -2 & 4\end{bmatrix}\begin{bmatrix}-2 & 0 & 1\\ 9 & 2 & -3\\ 6 & 1 & -2\end{bmatrix}$ to solve the system of equations:

$$x - y + 2z = 1$$
$$2y - 3z = 1$$
$$3x - 2y + 4z = 2$$

5

Q35 Let $f: R - \left\{-\frac{4}{3}\right\} \to R$ be a function defined as $f(x) = \frac{4x}{3x+4}$. Show that f is a one – one function. Also, check whether f is an onto function or not.

OR

Show that the function $f: (-\infty, 0) \to (-1,0)$ defined by $f(x) = \frac{x}{1+|x|}, x \in (-\infty, 0)$is one -one and onto. 5

SECTION – E

CASE BASED QUESTIONS

(All questions are compulsory. In case of internal choice, attempt any one question only)

Q36 Rohan wants to prepare a sweet box for Diwali at home. For making lower part of the box, he takes a square piece of cardboard of side 18cm. If x cm be the length of each side of the square cardboard which is to be cut off from the corner of the square piece of side 18cm.

Based on the above information, answer the following questions:

(i) Express V, volume of the open box formed by folding up the cutting corners in terms of x and find 2

the value of x for which $\frac{dV}{dx} = 0$

(ii) Rohan is interested in maximising the volume of the box. So what should be the side of the square to be cut off so that the volume of the box is maximum? 2

Q37 In a mathematics class, Mr. Sharma was explaining the topic of increasing and decreasing functions. He discussed various terms like stationary points and turning points and also explained the conditions under which a function is increasing or decreasing. Using different examples to clarify the concept, he then presented the function $f(x) = (x+1)^3(x-3)^3$. Based on this, can you answer the following questions?

(i) Find the stationary points on the curve. 2

(ii) Find the intervals where the function is increasing and decreasing. 2

Q38

Sherlin and Danju are playing Ludo at home. While rolling the dice, Sherlin's sister Raji observed and noted the possible outcomes of the throw every time belongs to set {1, 2, 3, 4, 5, 6}. Let A be the set of players while B be the set of all possible outcomes. A = {S, D}, B = {1, 2, 3, 4, 5, 6}

(i) Show that relation R : B ∈ B be defined by R = {(x, y) : y is divisible by x} is reflexive and symmetri not transitive. 2

(ii) Let R be a relation on B defined by R = {(1, 2), (2, 2), (1, 3), (3, 4), (3, 1), (4, 3), (5, 5)}. Then show that R is neither reflexive nor symmetric nor transitive. 2