ANANDALAYA
PERIODIC TEST – 2
Class: XII

विद्या सवर्थि साधिका

Subject : Mathematics (041) M.M: 80
Date : 22–09–2025 Time: 3 Hours

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 no. 1 to 18 are multiple choice questions (MCQs) and Questions no. 19 and 20 are Assertion-Reason based questions of 1 mark each.
4. In Section B, Questions no. 21 to 25 are Very Short Answer (VSA)-type questions, carrying 2 marks each.
5. In Section C, Questions no. 26 to 31 are Short Answer (SA)-type questions, carrying 3 marks each.
6. In Section D, Questions no. 32 to 35 are Long Answer (LA)-type questions, carrying 5 marks each.
7. In Section E, Questions no. 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 subpart each in 2 questions of Section E.
9. Use of calculators is not allowed.

SECTION – A

1. If $A = \begin{bmatrix} 2x & 0 \\ x & x \end{bmatrix}$ and $A^{-1} = \begin{bmatrix} 1 & 0 \\ -1 & 2 \end{bmatrix}$, then $x =$ ______. (1)

(A) 1 (B) 2 (C) $\frac{1}{2}$ (D) -2

2. The value of k for which $f(x) = \begin{cases} \frac{sin5x}{3x}, if\ x \neq 0 \\ k,\ \ if\ x = 0 \end{cases}$ is continuous at $x = 0$, is ______. (1)

(A) $\frac{1}{3}$ (B) $\frac{5}{3}$ (C) $\frac{3}{5}$ (D) 5

3. The interval on which the function $f(x) = 10 - 6x - 2x^2$ is strictly decreasing is______. (1)

(A) $\left(\frac{3}{2}, \infty\right)$ (B) $\left(\frac{-3}{2}, \infty\right)$ (C) $\left(-\infty, \frac{3}{2}\right)$ (D) $\left(-\infty, -\frac{3}{2}\right)$

4. The length x of a rectangle is decreasing at the rate of $5cm/minute$ and width y is increasing at the rate of 4 $cm/minute$ .When $x = 8\ cm\ and\ y = 6cm$, find the rate of change of the perimeter. (1)

(A) $9cm/min$ (B) $2cm/min$ (C) $1\ cm/min$ (D) $-2\ cm/min$

5. If $A = \begin{bmatrix} 1 & k & 3 \\ 3 & k & -2 \\ 2 & 3 & -4 \end{bmatrix}$ is singular, then $k =$ ____. (1)

(A) $\frac{16}{3}$ (B) $\frac{34}{3}$ (C) $\frac{33}{2}$ (D) -2

6. If $x^{2/3} + y^{2/3} = a^{2/3}$ then, $\frac{dy}{dx} =$ _____. (1)

(A) $\frac{-y^{1/3}}{x^{1/3}}$ (B) $\frac{-x^{1/3}}{y^{1/3}}$ (C) $\frac{y^{1/3}}{x^{1/3}}$ (D) $\frac{y^{1/3}}{x^{1/3}}$

7. Evaluate: $\int \frac{1}{\sqrt{x}+x} dx.$ (1)

(A) $2\log|1 + x| + C$ (B) $\log|1 + x| + C$ (C) $2\log\left|1 + \sqrt{x}\right| + C$ (D) $\tan^{-1}\sqrt{x}$

8. If $x = a\ sec\theta,\ \ y = b\ tan\theta$, then $\frac{dy}{dx} =$ _____. (1)

(A) $\frac{a}{b} cosec\theta$ (B) $\frac{b}{a} sec\theta$ (C) $\frac{b}{a} cot\theta$ (D) $\frac{b}{a}\ cosec\theta$

9. Let the set $X = \{m, n, o\}$ and the relation R is defined as $R = \{(m, o), (n, n), (o, n)\}$, then minimum ordered pairs which should be added in relation R to make it reflexive and symmetric are______________________. (1)

(A) $\{(m, m), (n, o), (m, n)\}$ (B) $\{(o, o), (o, m), (m, n)\}$

(C) $\{(m, m), (o, o), (o, m), (n, o)\}$ (D) $\{(m, m), (o, o), (o, m), (m, n)\}$

10. Evaluate: $\int_0^1 |2x - 1| \, dx$. (1)

(A) $-\frac{1}{2}$ (B) $\frac{3}{2}$ (C) $\frac{1}{2}$ (D) 1

11. Find the principal value of $\sin^{-1}\left(\sin\frac{3\pi}{4}\right)$. (1)

(A) $\frac{3\pi}{4}$ (B) $\frac{3\pi}{2}$ (C) $\frac{\pi}{4}$ (D) $\frac{\pi}{3}$

12. The matrix A satisfies the equation $\begin{bmatrix} 0 & 2 \\ -1 & 1 \end{bmatrix} A = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ then matrix A is ________. (1)

(A) $\begin{bmatrix} 2 & 0 \\ 1 & -1 \end{bmatrix}$ (B) $\begin{bmatrix} \frac{1}{2} & -2 \\ \frac{1}{2} & 0 \end{bmatrix}$ (C) $\begin{bmatrix} \frac{1}{2} & -1 \\ \frac{1}{2} & 0 \end{bmatrix}$ (D) $\begin{bmatrix} 1 & 2 \\ -1 & 0 \end{bmatrix}$

13. The function $f(x) = |x| \; for \; all \; x \in R$ is ________. (1)

(A) Continuous but not differentiable at x = 0 (B) Differentiable but not continuous at x = 0

(C) Neither Continuous nor differentiable at x = 0 (D) None of these

14. Evaluate: $\int \frac{sec^2x}{\sqrt{1 - tan^2x}} dx$. (1)

(A) $\sin^{-1}(tanx) + C$ (B) $\cos^{-1}(sinx) + C$

(C) $\tan^{-1}(cosx) + C$ (D) $\tan^{-1}(sinx) + C$

15. If $\begin{vmatrix} 2x + 5 & 3 \\ 5x + 2 & 9 \end{vmatrix} = 0$, then x is______. (1)

(A) 13 (B) 9 (C) –9 (D) –13

16. If $\int e^x\left(\frac{1}{x^2} - \frac{2}{x^3}\right) dx = A\frac{e^x}{x^2} + C$, find the value of A. (1)

(A) $-\frac{1}{2}$ (B) 2 (C) 3 (D) 1

17. If $A = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 4 & 0 \\ 0 & 0 & 4 \end{bmatrix}$, then find the value of $|adjA|$. (1)

(A) 4^3 (B) 4^2 (C) 4^6 (D) 4

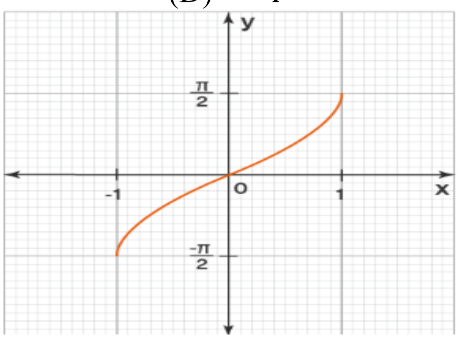
18. The adjoining graph represents : (1)

(A) $\cos^{-1} x$

(B) $\sin^{-1} x$

(C) $\text{cosec}^{-1} x$

(D) $\sin x$



For the following question number 19 and 20, choose the correct answer out of the following choices.

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

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

(C) Assertion (A) is true but Reason (R) is false

(D) Assertion (A) is false but Reason (R) is true

19. Let $A = [a_{ij}]$ be a matrix of order 3×3. (1)
(A): Expansion of determinant of A along second row or first column gives the same value.
(R): Expansion of determinant along any row or column gives the same value.

20. (A): $f: R \longrightarrow R$ defined by $f(x) = sinx$ is a bijective function. (1)
(R): If f is both one - one and onto, it is bijective function.

SECTION – B

21. Give an example to show that the union of two equivalence relations on a given set $A = \{1, 2, 3\}$ need not be an equivalence relation on A. (2)

22. A ladder 5 m long is leaning against a wall. The bottom of the ladder is pulled along the ground, away from the wall, at the rate of 2 cm/sec. How fast is its height on the wall decreasing when the foot of the ladder is 4m away from the wall. (2)

23. Evaluate: $\int tan^3x\, dx$. (2)

OR

Evaluate: $\int \frac{e^x}{\sqrt{5 - 4e^x - e^{2x}}} dx$.

24. Differentiate the following with respect to x, $y = \tan^{-1}\frac{x}{2} + \tan^{-1}\frac{2}{x}$. (2)

OR

If $x^y . y^x = 1$ find $\frac{dy}{dx}$.

25. If the matrix $\begin{bmatrix} -5 & x-y & 6 \\ 2 & 0 & 4 \\ x+y & z & 1 \end{bmatrix}$ is symmetric, find the value of $2x + y - 3z$. (2)

SECTION – C

26. Show that $y = \log(1 + x) - \frac{2x}{2+x}$, $x > -1$ is an increasing function of x throughout its domain. (3)

OR

A closed right circular cylinder has volume 2156 cubic units. What should be the radius of the base so that its total surface area may be minimum?

27. Evaluate: $\int_{\frac{\pi}{6}}^{\frac{\pi}{3}} \frac{dx}{1+\sqrt{cotx}}$. (3)

OR

Evaluate: $\int \frac{x^2-1}{x^2+4} dx$.

28. Express the matrix $A = \begin{bmatrix} -1 & 5 & 1 \\ 2 & 3 & 4 \\ 7 & 0 & 9 \end{bmatrix}$ as the sum of a symmetric and a skew- symmetric matrix. (3)

OR

Using co-factors of elements of second row, evaluate $\Delta = \begin{vmatrix} 5 & 3 & 8 \\ 2 & 0 & 1 \\ 1 & 2 & 3 \end{vmatrix}$

29. If $A = \begin{bmatrix} 3 & -2 \\ 4 & -2 \end{bmatrix}$, $I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$, then find the value of K, so that $A^2 + 2I = KA$. (3)

30. Find the value of k, for which $f(x) = \begin{cases} \frac{\sqrt{1+kx} - \sqrt{1-kx}}{x}, if\ -1 \le x < 0 \\ \frac{2x+1}{x-1}, \quad if\ 0 \le x < 1 \end{cases}$ is continuous at $x = 0$. (3)

31. Using properties of integration, evaluate: $\int_0^a x^2(a - x)^{3/2} dx$. (3)

SECTION- D

32. Using matrices, solve the system of linear equations: (5)
$3x + 4y + 2z = 8, \quad 2y - 3z = 3 \ , \qquad x - 2y + 6z = -2$

33. If $x = ae^{\theta}(sin\theta - cos\theta)$ and $y = ae^{\theta}(sin\theta + cos\theta)$ find $\frac{d^2y}{dx^2}$. (5)

OR

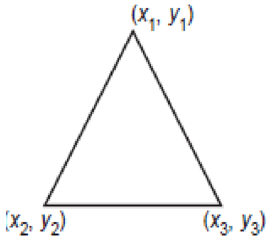
If $y = (\tan^{-1} x)^2$, prove that $(1+x^2)^2 y_2 + 2x(1+x^2)y_1 = 2$.

34. Evaluate: $\int \frac{dx}{x^3+x^2+x+1}$. **OR** Evaluate: $\int_0^{2\pi} \frac{1}{1+e^{sinx}} dx$. (5)

35. Let N be the set of all natural numbers and let R be a relation on N × N defined by $(a,b)R(c,d)$ such that $ad = bc$ for all $(a,b),(c,d) \in N \times N$. Show that R is an equivalence relation on $N \times N$. (5)

SECTION - E

36. Area of a triangle whose vertices are (x_1, y_1), (x_2, y_2) and (x_3, y_3) is given by the determinant Since, area is a positive quantity, so we always take the absolute value of the determinant. Also, the area of the triangle formed by three collinear points is zero. Based on the above information, answer the following questions.



$$\Delta = \frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

(i) Find the area of the triangle whose vertices are$(-2,6),(3,-6)$ and $(1,5)$. (1)
(ii) Using the determinants, find the equation of the line joining the points $A(1,3)$ and $B(0,0)$. (1)
(iii) (a) If the points $(2,-3),(k,-1)$ and $(0,4)$ are collinear, then find the value of k. (2)

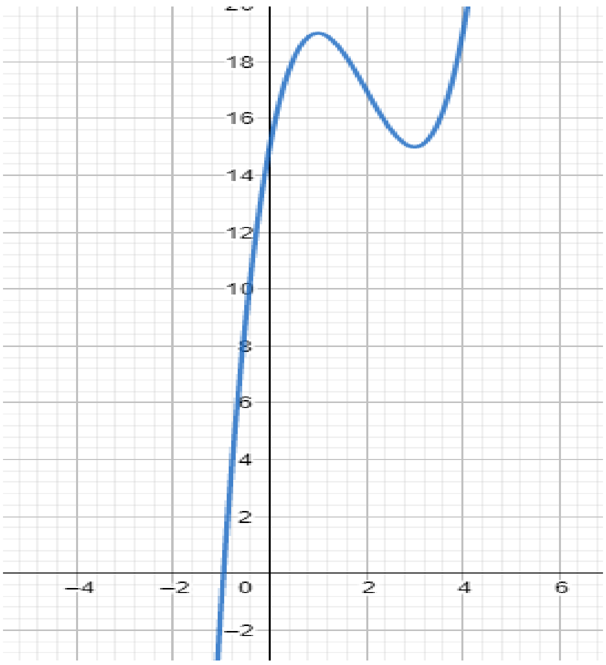
OR

(iii) (b) If the area of a Δ ABC with vertices A(1, 3), B(0, 0) and C(k, 0) is 6 sq units, then find the value of k.

37. Given the graph of the function:
$f(x) = x^3 - 6x^2 + 9x + 15.$
(i) Find the critical point of the function. (1)
(ii) Find all the points of local maxima and local minima of the function. (1)
(iii) (a) Find local minimum or local maximum values. (2)

OR

(b) Find the intervals in which the function is strictly increasing / strictly decreasing.



38. Aditi and Dhruv are playing Ludo at home. While rolling the dice, Aditi's sister Aastha observed and noted that possible outcomes of the throw every time belong to the set $\{1,2,3,4,5,6\}$. Let A be the set of players while B be the set of all possible outcomes.
Given $A = \{A, D\}$, $B = \{1,2,3,4,5,6\}$
(i) Let $R : B \longrightarrow B$ be defined by $R = \{(x,y): y \text{ is divisible by } x\}$. Show that relation R is reflexive but not symmetric. (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 check whether R is an equivalence relation. (2)