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Test / Exam Name: Volume 1 Test Standard: 12th Science Subject: Mathematics

Instructions

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Q1. If f and g are two functions from R to R defined as $f(x) = |x| + x$ and $g(x) = |x| - x$, then fog (x) for x<0 is **1 Mark**

A 4x **B** 2x **C** 0 **D** -4x

Q2. The value of $\tan^{-1}\left[\frac{1}{2}\cos^{-1}\left(\frac{\sqrt{5}}{3}\right)\right]$ is: **1 Mark**

A $\frac{3+\sqrt{5}}{2}$ **B** $\frac{3-\sqrt{5}}{2}$
C $\frac{-3+\sqrt{5}}{2}$ **D** $\frac{-3-\sqrt{5}}{2}$

Q3. The value of $\tan^{-1}\left(\tan\frac{7\pi}{6}\right)$ is: 1

A $\frac{\pi}{6}$ **B** $\frac{\pi}{2}$ **C** $\frac{\pi}{3}$ **D** $\frac{7\pi}{6}$

Q4. The function f(x) = |x| - x is: 1

A Continuous but not differentiable at x = 0.
B Continuous and differentiable at x = 0.
C Neither continuous nor differentiable at x = 0.
D Differentiable but not continuous at x = 0.

Q5. The function f: R → R given by f(x) = – |x – 1| is: 1

A Continuous as well as differentiable at x = 1.
B Not continuous but differentiable at x = 1.
C Continuous but not differentiable at x = 1.
D Neither continuous nor differentiable at x = 1.

Q6. If $\begin{bmatrix} x & 1 \end{bmatrix}\begin{bmatrix} 1 & 0 \\ -2 & 0 \end{bmatrix} = 0$, then x equals: 1

A 0 **B** -2 **C** -1 **D** 2

Q7. If A is a square matrix of order 3 and |A| = 5, then the value of |2A'| is: 1

A -10 **B** 10 **C** -40 **D** 40

Q8. The domain of the function $f(x) = \sin^{-1}(2x)$ is **1 Mark**

A $[0, 1]$ **B** $[-1, 1]$
C $\left[-\frac{1}{2}, \frac{1}{2}\right]$ **D** $[-2, 2]$

Q9. For what value of k may the function $\begin{cases} k(3x^2 - 5x), & x \le 0 \\ \cos x, & x > 0 \end{cases}$ become continuous? **1 Mark**

A 0 **B** 1 **C** $-\frac{1}{2}$ **D** No value

Q10. If $\begin{bmatrix} x & 2 \\ 3 & x-1 \end{bmatrix}$ is a singular matrix, then the product of all possible values of x is: **1 Mark**

A 6 **B** -6 **C** 0 **D** -7

Q11. The principal value of $\cot^{-1}(-\sqrt{3})$ is **1 Mark**

A $-\frac{\pi}{6}$ **B** $\frac{\pi}{6}$ **C** $\frac{2\pi}{3}$ **D** $\frac{5\pi}{6}$

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Q12. The function f : R→[– 1, 1] defined by $f(x) = \cos x$ is **1 Mark**

A Both one-one and onto. **B** Not one-one, but onto.
C One-one, but not onto. **D** Neither one-one, nor onto.

Q13. Which of the following statements is true for the function $f(x) = \begin{cases} x+3, & x \neq 0 \\ & ? \\ 1 & , \quad x = 0 \end{cases}$ **1 Mark**

A f(x) is continuous and differentiable $\forall\, x \in \mathbb{R}$ **B** f(x) is continuous $\forall\, x \in \mathbb{R}$
C f(x) is continuous and differentiable $\forall\, x \in \mathbb{R} - (0)$ **D** f(x) is discontinuous at infinitely many points

Q14. Let $A = \begin{bmatrix} 200 & 50 \\ 10 & 2 \end{bmatrix}$ and $B = \begin{bmatrix} 50 & 40 \\ 2 & 3 \end{bmatrix}$, then $|AB|$ is equal to **1 Mark**

A 460 **B** 2000 **C** 3000 **D** -7000

Q15. $\begin{bmatrix} x+1 & x-1 \\ x^2+x+1 & x^2-x+1 \end{bmatrix}$ is equal to: **1 Mark**

A $2x^3$ **B** 2 **C** 0 **D** $2x^3 - 2$

Q16. If $\cos\left(\sin^{-1}\frac{2}{\sqrt{5}} + \cos^{-1} x\right) = 0$, then x is equal to 1

A $\frac{1}{\sqrt{5}}$ **B** $-\frac{2}{\sqrt{5}}$ **C** $\frac{2}{\sqrt{5}}$ **D** 1

Q17. Let A = {2, 3, 4, 5, ..., 17, 18}. Let $'\simeq'$ be the equivalence relation on A × A, cartesian product of A with itself, defined by $(a, b) \simeq (c, d)$ if ad = bc. Then, the number of ordered pairs of the equivalence class of (3, 2) is: 1

A 4 **B** 5 **C** 6 **D** 7

Q18. The matrix $A = \begin{bmatrix} 0 & 0 & 4 \\ 0 & 4 & 0 \\ 4 & 0 & 0 \end{bmatrix}$ is a: 1

A Square matrix **B** Diagonal matrix **C** Unit matrix **D** None of these

Q19. **Directions:** In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as: 1

Assertion: The value of x for which $\begin{bmatrix} x & 2 \\ 18 & x \end{bmatrix} = \begin{bmatrix} 6 & 2 \\ 18 & 6 \end{bmatrix}$ is ± 6.

Reason: The determinant of a matrix A order 2x2, $A\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is = ab - dc.

A Both A and 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.
E Both A and R are false.

Q20. **Directions:** In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as: **1 Mark**
If A = {1, 2, 3}, B = {4,5, 6, 7} and f = {(1, 4), (2,5), (3, 6)} is a function from A to B.
Assertion: f(x) is a one - one function.
Reason: f(x) is an onto function.

A Both A and 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 and R is true.

Q21. If the product of two positive numbers is 9, find the numbers so that the sum of their squares is minimum. **2 Marks**

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Q22. If $A = \begin{bmatrix} -3 & 2 \\ 1 & -1 \end{bmatrix}$ and $I = \begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$, Find scalar k so that $A^2 + I = kA$. **2 Marks**

Q23. Find the absolute maximum and minimum values of the function $f(x) = 12x^{\frac{4}{3}} - 6x^{\frac{1}{3}}, x \in [0, 1]$. **2 Marks**

Q24. Differentiate $\tan^{-1}\left(\frac{1+\cos x}{\sin x}\right)$ with respect to x. **2 Marks**

Q25. If $A = \begin{bmatrix} p & 2 \\ 2 & p \end{bmatrix}$ and $|A^3| = 125$, then find the values of p. **2 Marks**

Q26. A stone is dropped into a quite lake and waves move in circles at the rate of 5 cm/s. At the instant when radius of the circular wave is 8 cm, how fast is the enclosed area increasing? **3 Marks**

Q27. Find $\frac{dy}{dx}$ in the following: **3 Marks**

$x^3 + x^2y + xy^2 + y^3 = 81$

Q28. Find the value of $\tan^{-1}\left(-\frac{1}{\sqrt{3}}\right) + \cot^{-1}\left(\frac{1}{\sqrt{3}}\right) + \tan^{-1}\left[\sin\left(\frac{-\pi}{2}\right)\right]$.

Q29. Find the matrix A such that

$$\begin{bmatrix} 2 & 1 & 3 \end{bmatrix} \begin{bmatrix} -1 & 0 & -1 \\ -1 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix} = A$$

Q30. If $x = a(\cos t + t \sin t)$ and $y = a(\sin t - t \cos t)$, find $\frac{d^2y}{dx^2}$

Q31. Find the intervals in which the following functions are increasing or decreasing.
$f(x) = 2x^3 - 9x^2 + 12x - 5$

Q32. A relation R on a set A is said to be an equivalence relation on A iff it is:

1. Reflexive i.e., $(a, a) \in R \; \forall \; a \in A$.
2. Symmetric i.e., $(a, b) \in R \Rightarrow (b, a) \in R \; \forall \; a, b \in A$.
3. Transitive i.e., $(a, b) \in R$ and $(b, c) \in R \Rightarrow (a, c) \in R \; \forall \; a, b, c \in A$.

Based on the above information, answer the following questions.

1. If the relation R = {(1, 1), (1, 2), (1, 3), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3)} defined on the set A = {1, 2, 3}, then R is:
1. Reflexive
2. Symmetric
3. Transitive
4. Equivalence
2. If the relation R = {(1, 2), (2, 1), (1, 3), (3, 1)} defined on the set A = {1, 2, 3}, then R is:
1. Reflexive
2. Symmetric
3. Transitive
4. Equivalence
3. If the relation R on the set N of all natural numbers defined as R = {(x, y): y = x + 5 and x < 4}, then R is:
1. Reflexive
2. Symmetric
3. Transitive
4. Equivalence
4. If the relation R on the set A = {1, 2, 3, ..., 13, 14} defined as R = {(x, y): 3x - y = O}, then R is:
1. Reflexive
2. Symmetric
3. Transitive

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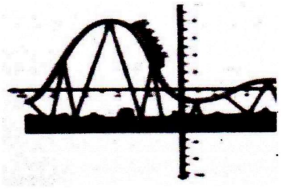
4. Equivalence

5. If the relation R on the set A = {I, 2, 3} defined as R = {(1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3)}, then R is:

1. Reflexive only
2. Symmetric only
3. Transitive only
4. Equivalence

Q33. The equation of the path traced by a roller-coaster is given by the polynomial f(x) = a (x + 9) (x + 1) (x - 3). If the roller-coaster crosses y-axis at a point (0, -1), answer the following: **4 Marks**



1. Find the value of 'a'.
2. Find f''(x) at x = 1.

Q34. **Read the case study given below and answer the questions that follow:** 4

A company is analyzing the profit function $P(x) = x^3 - 6x^2 + 9x$, where x represents the number of units sold. The company wants to understand the behavior of their profit function to optimize their sales strategy.

1. What is the derivative of the profit function P(x)?
2. Determine the critical points of the profit function P(x).
3. Find the second derivative of the profit function P(x) and interpret its significance at x = 1 and x = 3.

OR

3. Calculate the profit at the critical points x = 1 and x = 3, and determine which point yields a higher profit.

Q35. Show that the altitude of the right circular cone of maximum volume that can be inscribed in a sphere of radius r is $\frac{4r}{3}$. Also show that the maximum volume of the cone is $\frac{8}{27}$ of the volume of the sphere. 5

Q36. Find $\frac{dy}{dx}$ 5

$y = x^{\log x} + (\log x^x)$

Q37. Find the intervals in which the function $f(x) = x^3 - 12x^2 + 36x + 17$ is (a) increasing, (b) decreasing. 5

Q38. 5

If $A = \begin{bmatrix} 1 & -2 & 0 \\ 2 & -1 & -1 \\ 0 & -2 & 1 \end{bmatrix}$ find A^{-1} and use it to solve the following system of equations:

x - 2y = 10, 2x - y – z = 8, - 2y + z = 7

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