

SECTION – A (MATHEMATICS)**SECTION - I****MULTI OPTION CORRECT (+ 4, - 1, 0)**

1. Given that f is a real valued non-constant differentiable function such that $f(x) \cdot f'(x) \leq 0$, for all real x , then it follows that:

(A) $f^2(x)$ is increasing function	(B) $f^2(x)$ is decreasing function
(C) $f(x)$ has no critical point	(D) $f(x) = 0$ does not have any real root

2. Let $f(x) = \min.\{\phi(t), -3 \leq t \leq x\} \forall x \in [-3, \infty)$ where $\phi(x) = ||x-1| - |x+1||$, then

(A) $f(x)$ is non-differentiable at $x = -1, 0$	(B) $f(x)$ is non-differentiable at $x = -1, 1$
(C) $f(100) = 0$	(D) $\int_{-3}^{10} f(x) dx = 5$

3. Let $f(x)$ be twice differentiable function such that $f''(x) > 0$ in $[0, 2]$. Then

(A) $f(0) + f(2) = 2f(c)$ for atleast one $c \in (0, 2)$	(B) $f(0) + f(2) < 2f(1)$
(C) $f(0) + f(2) > 2f(1)$	(D) $2f(0) + f(2) > 3f\left(\frac{2}{3}\right)$

4. Let $f: R \rightarrow R$, such that $f''(x) - 2f'(x) + f(x) = 2e^x$ and $f'(x) > 0 \forall x \in R$, then which the following can be correct

(A) $ f(x) = -f(x), \forall x \in R$	(B) $ f(x) = f(x), \forall x \in R$	(C) $f(3) = -5$	(D) $f(3) = 7$
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5. If $\lim_{x \rightarrow \infty} (\sqrt{x^2 - x + 1} - ax - b) = 0$, then for $k \geq 2, k \in N$ which of the following is/are correct?
 (A) $2a + b = 0$ (B) $a + 2b = 0$ (C) $\lim_{n \rightarrow \infty} \sec^{2n}(k! \pi b) = 1$ (D) $\lim_{n \rightarrow \infty} \sec^{2n}(k! \pi a) = 1$
6. Let $f: R \rightarrow R$ defined by $f(x) = \text{Min.}(|x|, 1 - |x|)$. Then which of the following hold(s) good?
 (A) Range of f is $(-\infty, 1]$ (B) f is aperiodic
 (C) f is neither even nor odd (D) f is neither injective nor surjective

SECTION - II

Integer Type (+ 3, 0, 0).

7. Let $\{x_n\}$ be a sequence satisfying the recurrence relation $x_{n+1} = \frac{\sqrt{3}x_n - 1}{x_n + \sqrt{3}}$ ($n \geq 1$). The given sequence is periodic with period _____
8. If the function $f(x) = \frac{\tan(\tan x) - \sin(\sin x)}{\tan x - \sin x}$ ($x \neq 0$) is continuous at $x = 0$, then find the value of $f(0)$.
9. The value of $\lim_{x \rightarrow 0} \frac{\log_{\sec x/2} \cos x}{2 \log_{\sec x} (\cos x / 2)}$ is _____
10. Let $\alpha, \beta \in R$ be such that $\lim_{x \rightarrow 0} \frac{x^2 \tan(\alpha x)}{\beta x - \tan(2x)} = 1$, then value of $5\beta + 3\alpha$, is
11. If $\lim_{x \rightarrow 0} \frac{1 - \cos\left(1 - \cos \frac{x}{2}\right)}{2^m x^n}$ is equal to left hand derivative of $e^{-|x|}$ at $x = 0$, then find the value of $n - 10m$ is _____
12. If $\lim_{n \rightarrow \infty} \frac{e\left(1 - \frac{1}{n}\right)^n - 1}{n^\alpha}$ exists and is equal to non-zero constant c , then find the value of $12(c - \alpha)$.

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SECTION - III

Single Option Correct (+ 4, - 1, 0).

Paragraph for Questions Nos. 13 to 15

Let $f(\alpha) = \lim_{x \rightarrow 1} (\sin^{2x} \alpha + \cos^{2x} \alpha)^{\frac{1}{x-1}}$. Then

13. Number of points where $f(\alpha)$ is discontinuous in $[-\pi, \pi]$ is:

- (A) 0 (B) 2 (C) 7 (D) None of these

14. Which one of the following is correct?

- (A) $f'\left(\frac{\pi}{4}\right) = 1$ (B) $f'\left(\frac{\pi}{4}\right) = \frac{\pi}{4}$ (C) $f'\left(\frac{\pi}{4}\right) = 0$ (D) $f'\left(\frac{\pi}{4}\right) = \frac{1}{2}$

15. $\lim_{\alpha \rightarrow \frac{\pi}{4}} \left(f(\alpha) + f\left(\frac{\pi}{4}\right) \right)^{\frac{1}{\alpha - \frac{\pi}{4}}}$ is equal to

- (A) 0 (B) 1 (C) e (D) 1/e

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Paragraph for Questions Nos. 16 to 18

Let $f(x) = \lim_{n \rightarrow \infty} (1 - \sin x + \sqrt[n]{e} \cdot \sin x)^n$, $n \in \mathbb{N}$ and

$$a = \frac{2}{11} \lim_{x \rightarrow 0} \left(\left[\frac{\sin x}{x} \right] + \left[\frac{2 \sin x}{x} \right] + \left[\frac{3 \sin x}{x} \right] + \dots + \left[\frac{11 \sin x}{x} \right] \right), \quad b = \lim_{x \rightarrow 0} \left(\frac{x^2}{\left[\frac{\tan x}{x} \right] - \cos x} \right). \text{ Where } [.] = \text{GIF.}$$

16. The value of $(a + b)$ is equal to:

- (A) 2 (B) 6 (C) 10 (D) 12

17. Number of integral values of λ so that the equation $bx^2 - b^2x + \lambda = 0$ has roots α, β such that $1 < \alpha < 2$ and $2 < \beta < 3$ is:

- (A) 0 (B) 1 (C) 2 (D) 3

18. If $\lim_{u \rightarrow 0} \left[1 + \frac{u}{n} (1 + k^2) \right]^{1/u} = 2k \ln^2(f(x))$, $k > 0$ and $x \in (0, \pi)$, then the value of $(x + k)$ is equal to:

- (A) $1 + \frac{\pi}{4}$ (B) $1 + \frac{\pi}{2}$ (C) 1 (D) $\frac{\pi}{2}$

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ANSWER KEY

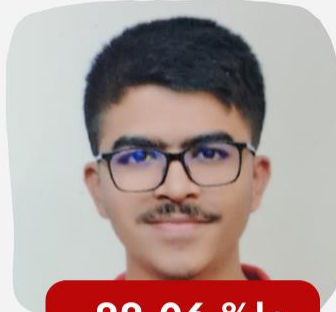
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|------------|------------|---------|---------|
| 1. B, C, D | 2. A, C, D | 3. C, D | 4. B, D |
| 5. B, C, D | 6. B, D | 7. 6 | 8. 2 |
| 9. 8 | 10. 2 | 11. 74 | 12. 6 |
| 13. A | 14. C | 15. B | 16. D |
| 17. A | 18. B | | |



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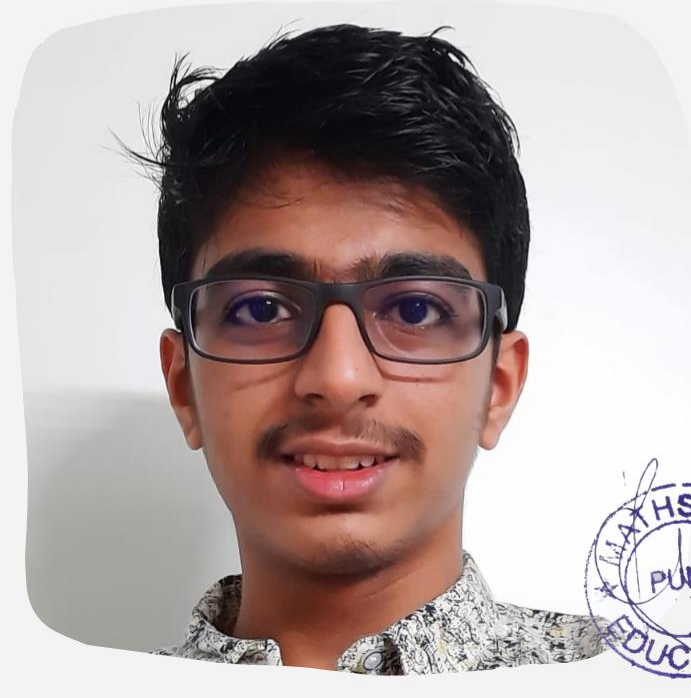
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