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 $f(x).f'(x) \le 0$, 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 $f(x)=\min.\{\phi(t),-3\le t\le x\}\ \forall\, x\in[-3,\infty)$ where $\phi(x)=\big||x-1|-|x+1|\big|$, 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 $f: R \longrightarrow R$, 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) $f(3)=7$

ROUGHT SPACE

5. If $\lim_{x\to\infty}\left(\sqrt{x^2-x+1}-ax-b\right)=0$, then for $k\geq 2, k\in N$ which of the following is/are correct?

(A) $2a+b=0$ (B) $a+2b=0$ (C) $\lim_{n\to\infty}\sec^{2n}(k!\,\pi b)=1$ (D) $\lim_{n\to\infty}\sec^{2n}(k!\,\pi a)=1$

6. Let $f:R\to R$ defined by $f(x)=Min.(|x|,1-|x|)$. 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 $\lim_{x\to 0}\frac{\log_{\sec x/2}\cos x}{2\log_{\sec x}(\cos x/2)}$ is _____

10. Let $\alpha,\beta\in R$ be such that $\lim_{x\to 0}\frac{x^2\tan(\alpha x)}{\beta x-\tan(2x)}=1$, then value of $5\beta+3\alpha$, is

11. If $\lim_{x\to 0}\frac{1-\cos\left(1-\cos\frac{x}{2}\right)}{2^m x^n}$ is equal to left hand derivative of $e^{-|x|}$ at x = 0, then find the value of n – 10m is _____

12. If $\lim_{n\to\infty}\frac{e\left(1-\frac{1}{n}\right)^n-1}{n^\alpha}$ exists and is equal to non-zero constant c, then find the value of $12(c-\alpha)$.

ROUGHT SPACE

SECTION – III

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

Paragraph for Questions Nos. 13 to 15

Let $f(\alpha)=\underset{x\to 1}{\text{Lim}}\left(\sin^{2x}\alpha+\cos^{2x}\alpha\right)^{\frac{1}{x-1}}$. 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. $\underset{\alpha\to\frac{\pi}{4}}{\text{Lim}}\left(f(\alpha)+f\left(\frac{\pi}{4}\right)\right)^{\frac{1}{\alpha-\frac{\pi}{4}}}$ is equal to

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

ROUGHT SPACE

Paragraph for Questions Nos. 16 to 18

Let $f(x)=\underset{n\to\infty}{Lim}\left(1-\sin x+\sqrt[n]{e}\cdot\sin x\right)^n, n\in N$ and

$a=\frac{2}{11}\underset{x\to0}{Lim}\left(\left[\frac{\sin x}{x}\right]+\left[\frac{2\sin x}{x}\right]+\left[\frac{3\sin x}{x}\right]+...+\left[\frac{11\sin x}{x}\right]\right)$, $b=\underset{x\to0}{Lim}\left(\frac{x^2}{\left[\frac{\tan x}{x}\right]-\cos x}\right)$. Where [.] = 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 $\underset{u\to0}{Lim}\left[1+\frac{u}{n}\left(1+k^2\right)\right]^{1/u}=2k\ln^2\left(f(x)\right), k>0$ 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) $\frac{\pi}{2}$

ROUGHT SPACE

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ANSWER KEY

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