# CUET (UG) – MATHEMATICS

Chapter Test -Calculus (Higher Order Derivatives, Increasing/Decreasing, Maxima/Minima)

**General Instructions**

1. Total Questions: **20**
2. Duration: **60 Minutes**
3. All questions are compulsory.
4. Each question carries **5 marks**.
5. For each correct answer: **+5 marks**.
6. For each incorrect answer: **-1 mark**.
7. No negative marking for unanswered questions.
8. Use of calculator or electronic devices is strictly prohibited.
9. Choose the most appropriate answer from the given options.

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1. If $y = \log(\sin x)$, then $\frac{d^2y}{dx^2}$ is equal to:
   (A) $-\text{cosec}^2 x$
   (B) $\text{cosec}^2 x$
   (C) $-\cot^2 x$
   (D) $\sec^2 x$

2. The function $f(x) = x^2 - 4x + 6$ is strictly increasing in the interval:
   (A) $(-\infty, 2)$
   (B) $(2, \infty)$
   (C) $(-\infty, -2)$
   (D) $(-2, 2)$

3. The maximum value of the function $f(x) = \sin x + \cos x$ is:
   (A) 1
   (B) 2
   (C) $\sqrt{2}$
   (D) $\sqrt{3}$

4. If $x = a\cos^3\theta$ and $y = a\sin^3\theta$, then $\frac{d^2y}{dx^2}$ at $\theta = \frac{\pi}{4}$ is:
   (A) $\frac{4\sqrt{2}}{3a}$
   (B) $\frac{3a}{4\sqrt{2}}$
   (C) $\frac{-4\sqrt{2}}{3a}$
   (D) 0

5. The function $f(x) = \frac{x}{\log x}$ increases in the interval:
   (A) $(0, e)$
   (B) $(e, \infty)$
   (C) $(0, 1)$
   (D) $(-\infty, e)$

6. The least value of the function $f(x) = ax + \frac{b}{x}$ (where $a, b, x > 0$) is:
   (A) $\sqrt{ab}$
   (B) $2\sqrt{ab}$
   (C) $ab$
   (D) $2ab$

7. If $f(x) = x^3 - 6x^2 + 9x + 15$, then the local maximum value of $f(x)$ is:
   (A) 19
   (B) 15
   (C) 17
   (D) 21

8. At which point does the function $f(x) = x^x$ have a stationary point?
   (A) $x = e$
   (B) $x = \frac{1}{e}$
   (C) $x = 1$
   (D) $x = \log e$

9. If $y = Ae^{5x} + Be^{-5x}$, then $\frac{d^2y}{dx^2}$ is equal to:
   (A) $5y$
   (B) $-25y$
   (C) $25y$
   (D) 0

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10. The function $f(x) = \cos x$ is strictly decreasing in the interval:
    (A) $(0, \pi)$
    (B) $(\pi, 2\pi)$
    (C) $(-\pi, 0)$
    (D) $(-\pi, \pi)$

11. The point on the curve $y = x^2$ which is closest to the point $(0, 5)$ is:
    (A) $(2, 4)$
    (B) $(\sqrt{2}, 2)$
    (C) $(\sqrt{4.5}, 4.5)$
    (D) $(0, 0)$

12. If $f(x) = kx - \sin x$ is monotonically increasing for all $x \in \mathbb{R}$, then:
    (A) $k < 1$
    (B) $k > 1$
    (C) $k \geq 1$
    (D) $k \leq 1$

13. The second order derivative of $e^x \sin x$ with respect to $x$ is:
    (A) $2e^x \cos x$
    (B) $2e^x \sin x$
    (C) $-2e^x \cos x$
    (D) $e^x(\sin x + \cos x)$

14. The function $f(x) = x^3 - 3x^2 + 3x - 100$ is:
    (A) Increasing for all $x \in \mathbb{R}$
    (B) Decreasing for all $x \in \mathbb{R}$
    (C) Increasing in $(1, \infty)$ only
    (D) Decreasing in $(-\infty, 1)$ only

15. The maximum area of a rectangle inscribed in a circle of radius $r$ is:
    (A) $r^2$
    (B) $2r^2$
    (C) $\sqrt{2}r^2$
    (D) $4r^2$

16. If $y = \tan^{-1} x$, then $(1 + x^2)\frac{d^2y}{dx^2} + 2x\frac{dy}{dx}$ is equal to:
    (A) 1
    (B) 0
    (C) $-1$
    (D) $x$

17. The interval in which $f(x) = 2x^3 - 15x^2 + 36x + 1$ is strictly decreasing is:
    (A) $(2, 3)$
    (B) $(-\infty, 2)$
    (C) $(3, \infty)$
    (D) $(-\infty, 3)$

18. If the sum of two non-zero numbers is 10, then the minimum value of the sum of their squares is:
    (A) 25
    (B) 50
    (C) 100
    (D) 75

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19. If $f''(x) < 0$ for all $x \in (a, b)$, then the curve $y = f(x)$ in this interval is:
    (A) Concave upwards
    (B) Concave downwards
    (C) A straight line
    (D) Linear

20. The absolute maximum value of $y = x^3 - 3x + 2$ in the closed interval $[0, 2]$ is:
    (A) 4
    (B) 2
    (C) 0
    (D) 6

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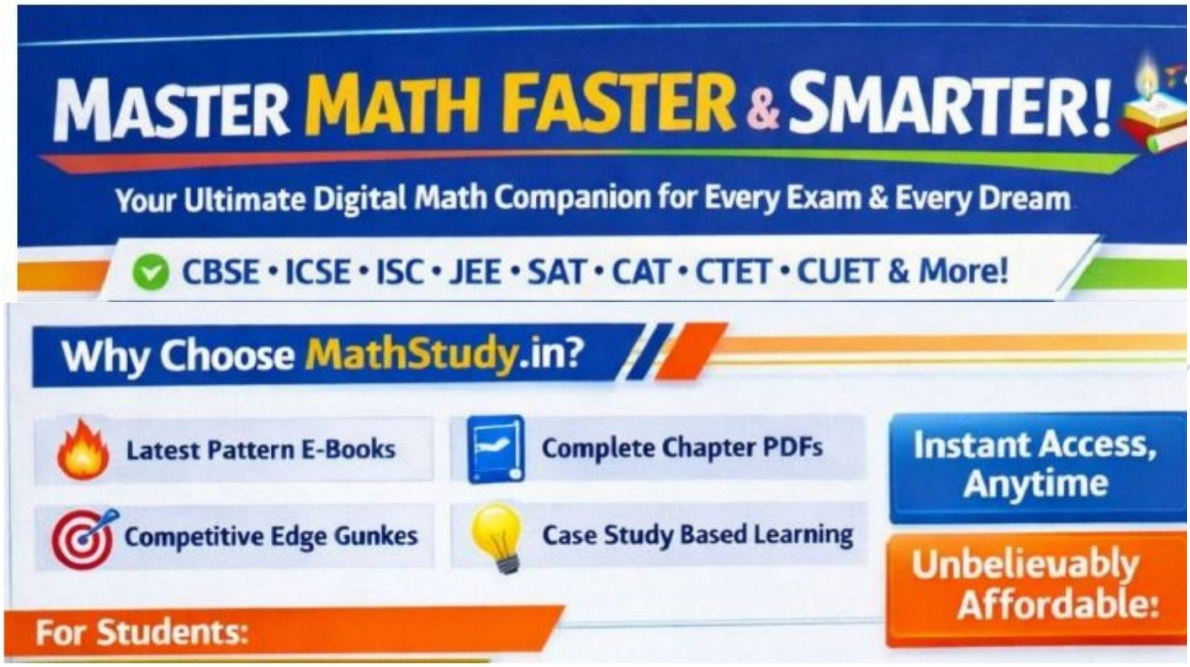


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