# NDA 1 2025

LIVE

# MATHS

## APPLICATIONS OF DERIVATIVES

CLASS 3


NAVJYOTI SIR

Crack
EXAMS

# 12 Dec 2024 Live Classes Schedule

| | | |
|---|---|---|
| 8:00AM | 12 DEC 2024 DAILY CURRENT AFFAIRS | RUBY MA'AM |
| 9:00AM | 12 DEC 2024 DAILY DEFENCE UPDATES | DIVYANSHU SIR |

## SSB INTERVIEW LIVE CLASSES

| | | |
|---|---|---|
| 9:30AM | OVERVIEW OF SRT & SDT | ANURADHA MA'AM |

## NDA 1 2025 LIVE CLASSES

| | | |
|---|---|---|
| 1:00PM | PHYSICS - MOTION - CLASS 2 | NAVJYOTI SIR |
| 4:30PM | ENGLISH - ACTIVE PASSIVE VOICE - CLASS 1 | ANURADHA MA'AM |
| 5:30PM | MATHS - APPLICATIONS OF DERIVATIVES - CLASS 3 | NAVJYOTI SIR |

## CDS 1 2025 LIVE CLASSES

| | | |
|---|---|---|
| 1:00PM | PHYSICS - MOTION - CLASS 2 | NAVJYOTI SIR |
| 4:30PM | ENGLISH - ACTIVE PASSIVE VOICE - CLASS 1 | ANURADHA MA'AM |
| 7:00PM | MATHS - STATISTICS - CLASS 1 | NAVJYOTI SIR |



**Q)** The motion of a particle is described as $s = 2 - 3t + 4t^3$. What is the acceleration of the particle at the point where its velocity is zero?

(a) 0 (b) 4 unit

(c) 8 unit (d) 12 unit

$$v = \frac{ds}{dt} = -3 + 12t^2$$

$$v = 0$$

$$-3 + 12t^2 = 0 \Rightarrow t^2 = \frac{3}{12} \Rightarrow t = \frac{1}{2}$$

(t cannot be -ve)

$$a = \frac{dv}{dt} = 24t$$

$$a = 24 \times \left(\frac{1}{2}\right) = 12$$

**Q)** The motion of a particle is described as $s = 2 - 3t + 4t^3$. What is the acceleration of the particle at the point where its velocity is zero?

(a) 0
(b) 4 unit
(c) 8 unit
(d) 12 unit

**Ans: (d)**

**Q)** What is the maximum slope of the curve $y = -x^3 + 3x^2 + 2x - 27$ ?

(a) 1 (b) 2

(c) 5 (d) $-23$

Slope (m) $= \frac{dy}{dx} = -3x^2 + 6x + 2$

first derivative of m (slope)

$\frac{dm}{dx} = -6x + 6$

finding critical points for m

$-6x + 6 = 0 \Rightarrow x = 1$

Second derivative of m

$\frac{d^2m}{dx^2} = -6 < 0$

$-3(1) + 6(1) + 2$

5

So, $x = 1$ is a point of maxima,

**Q)** What is the maximum slope of the curve $y = -x^3 + 3x^2 + 2x - 27$ ?

(a) 1 (b) 2

(c) 5 (d) $-23$

**Ans: (c)**

**Q)** Let $a$ and $b$ be two distinct roots of a polynomial equation $f(x)=0$. Then there exists at least one root lying between $a$ and $b$ of the polynomial equation.

(a) $f(x)=0$ (b) $f'(x)=0$

(c) $f''(x)=0$ (d) None of these

$f(a) = f(b) = 0$ Rolle's Theorem

$f'(c) = 0 \Rightarrow f'(x) = 0$

**Q)** Let $a$ and $b$ be two distinct roots of a polynomial equation $f(x)=0$. Then there exists at least one root lying between $a$ and $b$ of the polynomial equation.

(a) $f(x)=0$ (b) $f'(x)=0$

(c) $f''(x)=0$ (d) None of these

**Ans: (b)**

**Q)** If $f(x) = 3x^2 + 6x - 9$, then

(a) $f(x)$ is increasing in $(-1, 3)$

(b) $f(x)$ is decreasing in $(3, \infty)$

(c) $f(x)$ is increasing in $(-\infty, -1)$

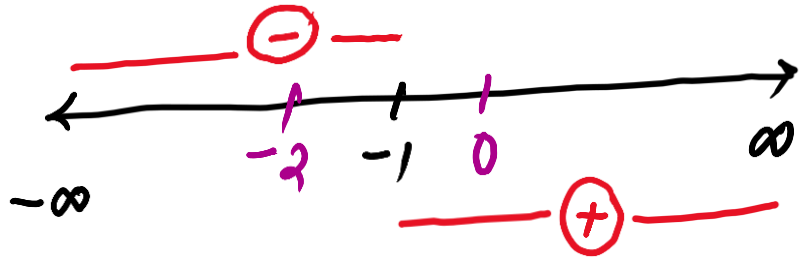
(d) $f(x)$ is decreasing in $(-\infty, -1)$ ✓

$f'(x) = 6x + 6$

$f'(x) = 0$

$6x + 6 = 0$

$x = -1$




decreasing in $(-\infty, -1)$

**Q)** If $f(x) = 3x^2 + 6x - 9$, then

(a) $f(x)$ is increasing in $(-1, 3)$

(b) $f(x)$ is decreasing in $(3, \infty)$

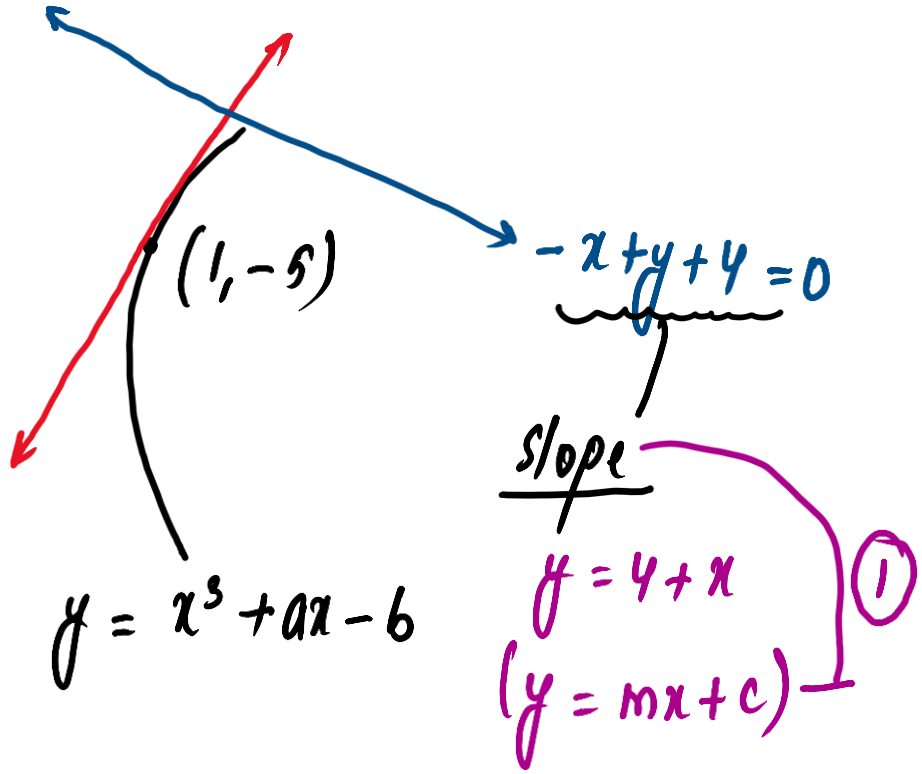
(c) $f(x)$ is increasing in $(-\infty, -1)$

(d) $f(x)$ is decreasing in $(-\infty, -1)$

**Ans: (d)**

**Q)** If the tangent to the curve, $y = x^3 + ax - b$ at the point $(1, -5)$ is perpendicular to the line, $-x + y + 4 = 0$, then which one of the following points lies on the curve ?

(a) $(-2, 2)$ (b) $(2, -2)$
(c) $(-2, 1)$ (d) $(2, -1)$




$-5 = 1^3 + a(1) - b$

$a - b = -6$ —— (1)

slope of tangent at $(1,-5)$

$\frac{dy}{dx} = 3x^2 + a$

$\frac{dy}{dx}_{(1,-5)}$

$= 3(1)^2 + a = 3 + a$

$(3+a)(1) = -1$ (As lines are perpendicular)

$a = -4$

$a - b = -6$

$-4 - b = -6$

$b = 2$

$y = x^3 + ax - b$

$y = x^3 - 4x - 2$

put options and check,

(a) $(-2, 2)$ —— ✗

(b) $(2, -2)$ —— ✓

**Q)** If the tangent to the curve, $y = x^3 + ax - b$ at the point $(1, -5)$ is perpendicular to the line, $-x + y + 4 = 0$, then which one of the following points lies on the curve ?

(a) $(-2, 2)$
(b) $(2, -2)$
(c) $(-2, 1)$
(d) $(2, -1)$

**Ans: (b)**

**Q)** What is the slope of the normal at the point $(at^2, 2at)$ of the parabola $y^2 = 4ax$ ?

(a) $\frac{1}{t}$ (b) $t$

(c) $-t$ (d) $-\frac{1}{t}$

$y^2 = 4ax$

$2y\frac{dy}{dx} = 4a$

slope of tangent

$\frac{dy}{dx} = \frac{4a}{2y} = \frac{2a}{y}$

At $(at^2, 2at)$

$\frac{2a}{2at} = \frac{1}{t}$

Slope of normal, $\frac{-1}{(\frac{1}{t})} = -t$

**Q)** What is the slope of the normal at the point $(at^2, 2at)$ of the parabola $y^2 = 4ax$ ?

(a) $\frac{1}{t}$

(b) $t$

(c) $-t$

(d) $-\frac{1}{t}$

**Ans: (c)**

**Q)** If $\sin x \cos y = \frac{1}{2}$, then what is the value of $\frac{d^2y}{dx^2}$ at $\left(\frac{\pi}{4}, \frac{\pi}{4}\right)$?

(a) –4
(b) –2
(c) –6
(d) 0

$$\cos y \cos x + \sin x(-\sin y)\frac{dy}{dx} = 0$$

$$\frac{dy}{dx} = -\frac{\cos y \cos x}{-\sin x \sin y} = \cot x \cot y$$

$$\frac{d^2y}{dx^2} = \cot x\left(-\operatorname{cosec}^2 y\right)\left(\frac{dy}{dx}\right) + \cot y\left(-\operatorname{cosec}^2 x\right)$$

$$\frac{d^2y}{dx^2} \text{ at } \left(\frac{\pi}{4}, \frac{\pi}{4}\right)$$

$$1(-2)(1) + (1)(-2)$$

$$= -2 - 2 = -4$$

**Q)** If $\sin x \cos y = \frac{1}{2}$, then what is the value of $\frac{d^2y}{dx^2}$ at $\left(\frac{\pi}{4}, \frac{\pi}{4}\right)$?

(a) $-4$
(b) $-2$
(c) $-6$
(d) $0$

**Ans: (a)**

**Q)** A wire 34 cm long is to be bent in the form of a quadrilateral of which each angle is 90°. What is the maximum area which can be enclosed inside the quadrilateral?

(a) $68\ cm^2$ (b) $70\ cm^2$

(c) $71.25\ cm^2$ (d) $72.25\ cm^2$

rectangle

$2(l+b) = 34$

$l+b = 17$

Max. area for rectangle } $l = b$ (it forms a square)

$l = b = \frac{17}{2}$

$\text{area} = \frac{17}{2} \times \frac{17}{2} = \frac{298}{4} = 72.25\ cm^2$

**Q)** A wire 34 cm long is to be bent in the form of a quadrilateral of which each angle is 90°. What is the maximum area which can be enclosed inside the quadrilateral?

(a) $68\ cm^2$ (b) $70\ cm^2$

(c) $71.25\ cm^2$ (d) $72.25\ cm^2$

**Ans: (d)**

**Q)** What is the area of the largest rectangular field which can be enclosed with 200 m of fencing ?

(a) $1600\,m^2$ (b) $2100\,m^2$

(c) $2400\,m^2$ (d) $2500\,m^2$

$2(l+b) = 200$

$l+b = 100$

$l = b$ (max. area)

$l = b = 50$

Area $= 50 \times 50$

$= 2500\ m^2$

**Q)** What is the area of the largest rectangular field which can be enclosed with 200 m of fencing ?

(a) $1600\,m^2$ (b) $2100\,m^2$

(c) $2400\,m^2$ (d) $2500\,m^2$

**Ans: (d)**

**Q)** The maximum value of $\frac{\ln x}{x}$ is $f(x)$

(a) e (b) $\frac{1}{e}$ (c) $\frac{2}{e}$ (d) 1

First derivative

$$f'(x) = \frac{x\left(\frac{1}{x}\right) - \ln x\,(1)}{x^2} = \frac{1-\ln x}{x^2}$$

critical points, $\frac{1-\ln x}{x^2} = 0$

$1 - \ln x = 0 \Rightarrow \ln x = 1 \Rightarrow x = e$

second derivative

$$f''(x) = \frac{x^2\left(-\frac{1}{x}\right) + (1-\ln x)(2x)}{x^4}$$

$$= \frac{-x + 2x - 2x\ln x}{x^4}$$

$$= \frac{1-2\ln x}{x^3}$$

$$f''(e) = \frac{1-2(1)}{e^3} = \frac{-1}{e^3}$$

$$f''(e) = \frac{-1}{e^3} < 0$$

$x = e$ is a point of maxima,

$$f(x) = \frac{\ln x}{x}$$

max. value of $f(x) = \frac{\ln e}{e} = \frac{1}{e}$

**Q)** The maximum value of $\frac{\ln x}{x}$ is

(a) $e$ (b) $\frac{1}{e}$ (c) $\frac{2}{e}$ (d) 1

**Ans: (b)**

**Q)** The velocity of telegraphic communication is given by $v = x^2 \log(1/x)$, where $x$ is the displacement. For maximum velocity, $x$ equals to?

(a) $e^{1/2}$ (b) $e^{-1/2}$

(c) $(2e)^{-1}$ (d) $2e^{-1/2}$

$$v = x^2 \log\left(\frac{1}{x}\right)$$

$$v = x^2(-\log x) = -x^2 \log x$$

$$\frac{dv}{dx} = -2x\log x - x^2 \cdot \frac{1}{x}$$

$$= -2x\log x - x$$

For max. $v$,

$$\frac{dv}{dx} = 0$$

$$-2x\log x - x = 0$$

$$x(-2\log x - 1) = 0$$

$x = 0$ ; $-2\log x - 1 = 0$

$$\log x = -\frac{1}{2}$$

$$x = e^{-1/2}$$

**Q)** The velocity of telegraphic communication is given by $v = x^2 \log(1/x)$, where $x$ is the displacement. For maximum velocity, $x$ equals to?

(a) $e^{1/2}$ (b) $e^{-1/2}$

(c) $(2e)^{-1}$ (d) $2e^{-1/2}$

**Ans: (b)**

**Q)** The maximum value of $\sin\left(x+\frac{\pi}{5}\right)+\cos\left(x+\frac{\pi}{5}\right)$, where $x \in \left(0, \frac{\pi}{2}\right)$, is attained at

(a) $\frac{\pi}{20}$ (b) $\frac{\pi}{15}$ (c) $\frac{\pi}{10}$ (d) $\frac{\pi}{2}$

**Q)** The maximum value of $\sin\left(x+\frac{\pi}{5}\right)+\cos\left(x+\frac{\pi}{5}\right)$, where $x \in \left(0, \frac{\pi}{2}\right)$, is attained at

(a) $\frac{\pi}{20}$ (b) $\frac{\pi}{15}$ (c) $\frac{\pi}{10}$ (d) $\frac{\pi}{2}$

**Ans: (a)**

**Q)** What is the maximum value of $16\sin\theta - 12\sin^2\theta$?

(a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) $\frac{16}{3}$ (d) 4

**Q)** What is the maximum value of $16\sin\theta - 12\sin^2\theta$?

(a) $\frac{3}{4}$ (b) $\frac{4}{3}$ (c) $\frac{16}{3}$ (d) 4

**Ans: (c)**

**Q)** What is the minimum value of $a^2x + b^2y$ where $xy = c^2$ ?

(a) $abc$ (b) $2abc$

(c) $3abc$ (d) $4abc$

**Q)** What is the minimum value of $a^2x + b^2y$ where $xy = c^2$ ?

(a) $abc$ (b) $2abc$

(c) $3abc$ (d) $4abc$

**Ans: (b)**

**Q)** If $y = |\sin x|^{|x|}$, then what is the value of $\frac{dy}{dx}$ at $x = \frac{\pi}{6}$ ?

(a) $\frac{2^{-\frac{\pi}{6}}\left(6\,\ell n2 - \sqrt{3}\pi\right)}{6}$

(b) $\frac{2^{\frac{\pi}{6}}\left(6\,\ell n2 + \sqrt{3}\pi\right)}{6}$

(c) $\frac{2^{-\frac{\pi}{6}}\left(6\,\ell n2 + \sqrt{3}\pi\right)}{6}$

(d) $\frac{2^{\frac{\pi}{6}}\left(6\,\ell n2 - \sqrt{3}\pi\right)}{6}$

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(c) $\frac{2^{-\frac{\pi}{6}}\left(6\,\ell n2 + \sqrt{3}\pi\right)}{6}$

(d) $\frac{2^{\frac{\pi}{6}}\left(6\,\ell n2 - \sqrt{3}\pi\right)}{6}$

**Ans: (a)**

**Q)** Which one of the following is correct in respect of the function

$$f(x) = x \sin x + \cos x + \frac{1}{2}\cos^2 x \, ?$$

(a) It is increasing in the interval $\left(0, \frac{\pi}{2}\right)$

(b) It remains constant in the interval $\left(0, \frac{\pi}{2}\right)$

(c) It is decreasing in the interval $\left(0, \frac{\pi}{2}\right)$

(d) It is decreasing in the interval $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$

**Q)** Which one of the following is correct in respect of the function

$$f(x) = x \sin x + \cos x + \frac{1}{2}\cos^2 x \, ?$$

(a) It is increasing in the interval $\left(0, \frac{\pi}{2}\right)$

(b) It remains constant in the interval $\left(0, \frac{\pi}{2}\right)$

(c) It is decreasing in the interval $\left(0, \frac{\pi}{2}\right)$

(d) It is decreasing in the interval $\left(\frac{\pi}{4}, \frac{\pi}{2}\right)$

**Ans: (a)**

**Q)** What is the minimum value of $[x(x-1)+1]^{\frac{1}{3}}$, where $a \leq x \leq 1$?

(a) $\left(\frac{3}{4}\right)^{\frac{1}{3}}$ (b) 1 (c) $\frac{1}{2}$ (d) $\left(\frac{3}{8}\right)^{1/3}$

**Q)** What is the minimum value of $[x(x-1)+1]^{\frac{1}{3}}$, where $a \le x \le 1$?

(a) $\left(\frac{3}{4}\right)^{\frac{1}{3}}$ (b) 1 (c) $\frac{1}{2}$ (d) $\left(\frac{3}{8}\right)^{1/3}$

**Ans: (a)**

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# MATHS

## APPLICATIONS OF DERIVATIVES

CLASS 4


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