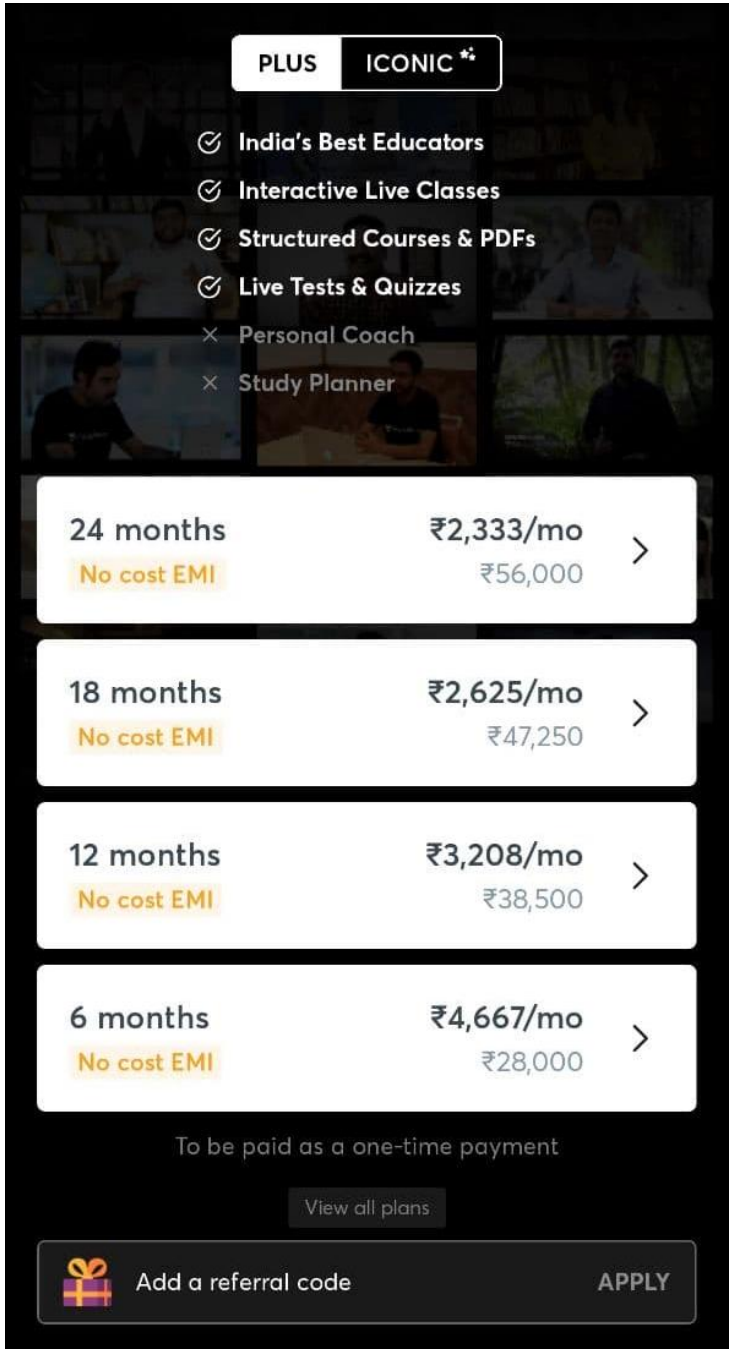
"आज PHYSICS में मचाते हैं।"

SIR PRATEEK JAIN

. IIT JEE & NEET FACULTY (KOTA)
. TOP PHYSICS FACULTY ON UNACADEMY.
. 8+ YEARS OF TEACHING EXPERIENCE
. RESEARCH WORK WITH HC VERMA SIR AT IIT KANPUR
. PRODUCED RANKS LIKE AIR 6, AIR 10 ETC.



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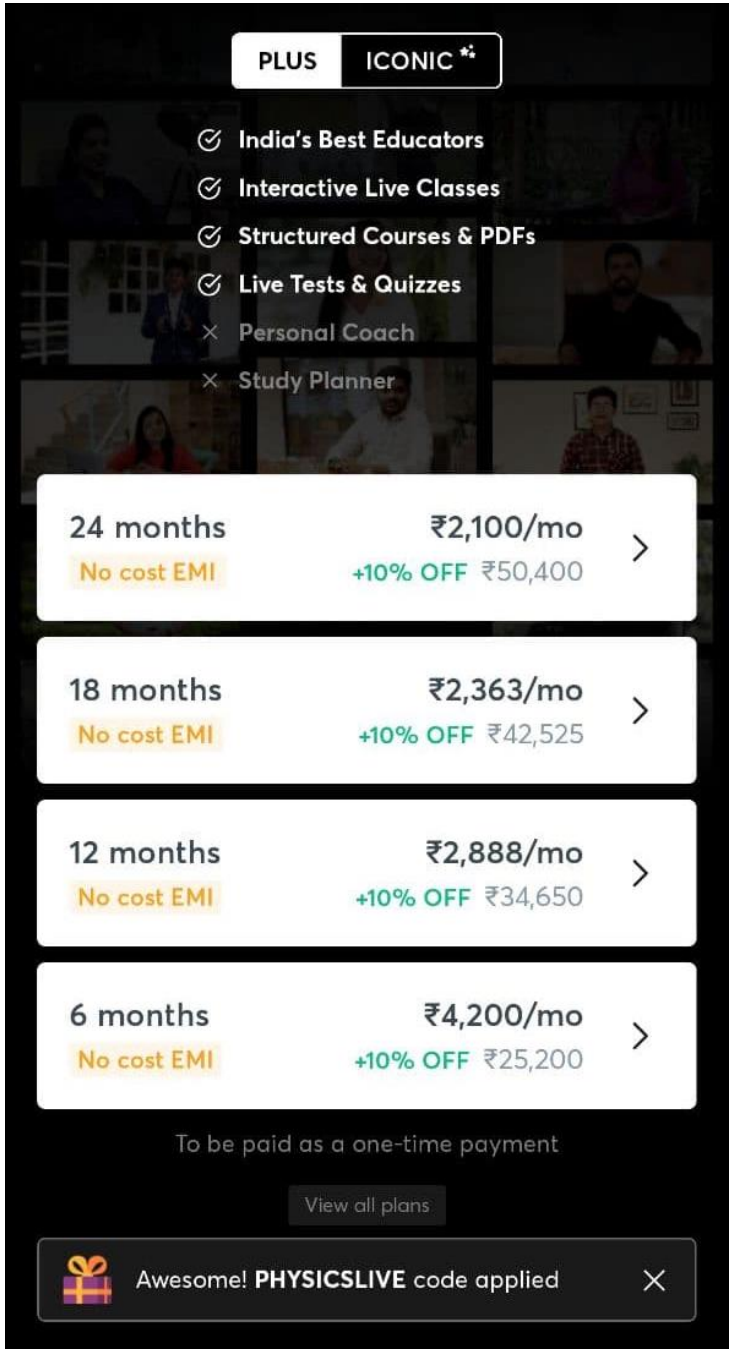

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IIT JEE
Physics DPP

DPP-6: Basic Math: Applications of Differentiation (Maxima & Minima)

By Physicsaholics Team

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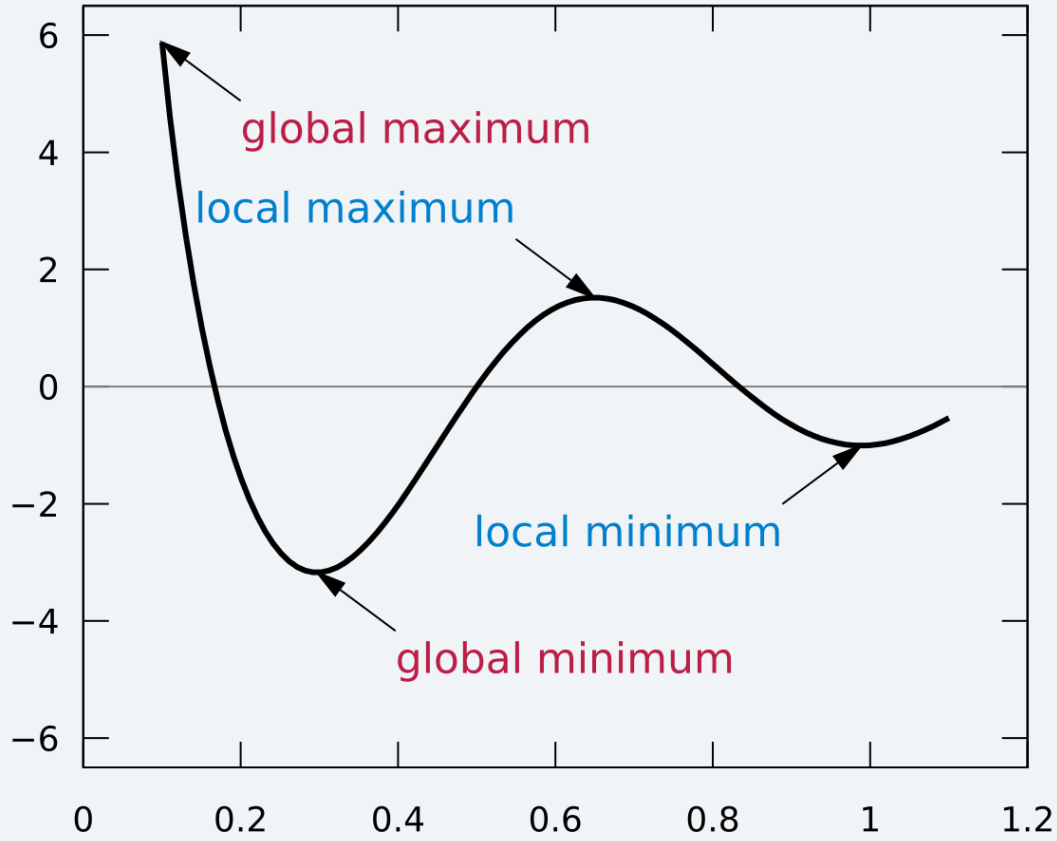
Maxima & Minima



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Q) x varies with time as : $x = (3t^2 - 2)$, then minimum value of x is:

(a) 2 (b) -2 (c) zero (d) $-\infty$

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Ans. b

$x = 3t^2 - 2$

$\frac{dx}{dt} = 6t$

$\frac{dx}{dt} = 0$ [for max & Min]

$6t = 0$

$\boxed{t = 0}$

$\frac{d^2x}{dt^2} = 6 > 0$

$\therefore$ at $t = 0$, function will have minima.

$x_{min} = 3(0) - 2$

$\boxed{x_{min} = -2}$

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Q) Maximum value of $y = 3\sin x + 4\cos x$ is:

(a) 5 (b) $\frac{5}{\sqrt{2}}$ (c) 1 (d) ∞

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Ans. a

$y = 3\sin x + 4\cos x$

for $y = a\sin x + b\cos x$

$$y_{max} = \sqrt{a^2 + b^2}$$

$$\therefore y_{max} = \sqrt{3^2 + 4^2}$$

$$\boxed{y_{max} = 5}$$

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Q) Function $y = x^3 - 2x + 1$ will have its maxima at 'x' equal to:

(a) $\frac{2}{3}$ (b) $\sqrt{\frac{2}{3}}$ (c) $-\sqrt{\frac{2}{3}}$ (d) $\sqrt{\frac{3}{2}}$

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Ans. c

$y = x^3 - 2x + 1$

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

for max. or min:

$\frac{dy}{dx} = 0 \Rightarrow 3x^2 - 2 = 0 \Rightarrow x = \pm\sqrt{\frac{2}{3}}$

Now, $\frac{d^2y}{dx^2} = 6x$

for $x = +\sqrt{\frac{2}{3}} \Rightarrow \frac{d^2y}{dx^2} > 0 \Rightarrow$ minima

for $x = -\sqrt{\frac{2}{3}} \Rightarrow \frac{d^2y}{dx^2} < 0 \Rightarrow$ maxima

$\therefore$ function will have maxima at $x = -\sqrt{\frac{2}{3}}$

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Q) Function $y = F(x)$ has its maxima value at x $= x_1$, then:

(a) $F'(x_1) > 0$

(b) $F'(x_1) < 0$

(c) $F''(x_1) > 0$

(d) $F''(x_1) < 0$

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Ans. d

$y = f(x)$

For maxima at, $x = x_1$

$f'(x_1) = 0$

and $f''(x_1) < 0$

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Q) Number of minima for $y = \frac{x^3}{3} - 4x + 1$ are:

(a) 1
(b) 2
(c) 3
(d) zero

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Ans. a

$$y = \frac{x^3}{3} - 4x + 1$$

$$\frac{dy}{dx} = \frac{3x^2}{3} - 4$$

$$\frac{dy}{dx} = x^2 - 4$$

for max. & minima:

$$\frac{dy}{dx} = 0 \Rightarrow x^2 - 4 = 0$$

$$\Rightarrow \boxed{x = \pm 2}$$

Now; $\frac{d^2y}{dx} = 2x$

for; $x = -2$; $\frac{d^2y}{dx} = -4 < 0 \Rightarrow$ maxima

for; $x = 2$; $\frac{d^2y}{dx^2} = 4 > 0 \Rightarrow$ minima

So; function will have 1 minima at, $x = +2$

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Q) Let $f(x) = x^3 - 12x + 7$. Which of the following statement is correct?

(a) The graph of y = f(x) has minimum, at x = -2

(b) The graph of y = f(x) has maximum, at x = 0

(c) The graph of y = f(x) has minimum, at x = 2

(d) None of these

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Ans. c

$f(x) = x^3 - 12x + 7$

$f'(x) = 3x^2 - 12$

for max & min.

$f'(x) = 3x^2 - 12 = 0 \Rightarrow x^2 = 4$

$\boxed{x = \pm 2}$

Now; $\frac{d^2y}{dx^2} = f''(x) = 6x$

for; $x = 2$, $\frac{d^2y}{dx^2} = 12 > 0 \Rightarrow$ Minima

for; $x = -2$; $\frac{d^2y}{dx^2} = -12 < 0 \Rightarrow$ Maxima

$\therefore$ $f(x)$ will have its maxima

at, $x = -2$

and, Minimum, at, $x = +2$

Q) Let $f(x) = \sin x + \sqrt{3}\cos x$. Which of the following statement is correct?

(a) The graph of y = f(x) has minimum value $y = -1$

(b) The graph of y = f(x) has maximum value $y = 1$

(c) The graph of y = f(x) has minimum value $y = -2$

(d) None of these

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Ans. c

$y = \sin x + \sqrt{3}\cos x$

for $y = a\sin x + b\cos x$

$y_{min} = -\sqrt{a^2+b^2}$

$\therefore y_{min} = -\sqrt{1^2+(\sqrt{3})^2}$

$\boxed{y_{min} = -2}$

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Q) What will be the maximum value of $y = 3 \sin x$ for interval $x \in [0, 2\pi]$?

(a) 3

(b) 1

(c) -3

(d) -1

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Ans. a

$y = 3\sin x$

We know $-1 \le \sin x \le 1$

So, $\max(\sin x) = 1$

$\therefore y_{max} = 3 \times 1 = 3$

(or)

$\frac{dy}{dx} = 3\cos x$

For max & min.

$\frac{dy}{dx} = 3\cos x = 0$

$\Rightarrow \cos x = 0; \quad x = \frac{\pi}{2}, \frac{3\pi}{2}, \ldots$

$\frac{d^2y}{dx^2} = -3\sin x$

at, $x = \pi/2$, $\frac{d^2y}{dx^2} = -3 < 0 \Rightarrow$ Maximum

at, $x = 3\pi/2$, $\frac{d^2y}{dx^2} = +3 > 0 \Rightarrow$ Minima

$\therefore$ Max. at, $x = \pi/2$, $y_{max} = 3\sin\frac{\pi}{2}$

$\boxed{y_{max} = 3}$

Q) What is true about the derivative of a function at a maximum or minimum point of the function?

(a) The derivative is equal to zero.

(b) The derivative is always positive.

(c) The derivative is always negative.

(d) None of these are correct.

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Ans. a

$y = f(x)$

For max. & min.

derivative of function $f(x)$

$\frac{dy}{dx}$ or $f'(x) = 0$

Because, at point of max. or min.
slope of curve will be zero.

$\therefore \boxed{\frac{dy}{dx} = 0}$

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Q) Suppose we found the point (3,19) to be a minimum point of the function f. What must be true about the second derivative of f evaluated at $x = 3$?

(a) It must be less than zero

(b) It must be greater than zero

(c) It must be equal to zero

(d) None of these are correct

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Ans. b

$y = f(x)$

$y = f(x)$ has

minima, at, $x = 3$

& min. of $f(x) = 19$

value

for minima, $\frac{d^2y}{dx^2} > 0$

so, at, $x = 3$

$$\boxed{f''(3) > 0}$$

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