

MATHEMATICS · JEE MAIN

Differentiation

Chapter-wise previous year questions, with answer key

33

PYQS

2020–2024

PAPERS

6

TOPICS

Derivatives of Standard Functions

Chain Rule

Implicit Differentiation

Higher Order Derivatives

Parametric Differentiation

Product and Quotient Rule

- 1 Attempt each question on paper first — they're grouped by topic, newest papers first.
- 2 Check yourself against the answer key at the end.
- 3 Got one wrong? Tap “Step-by-step solution” under it for the full working.

Stuck on a question?

Every question has a free step-by-step solution on PrepWiser — tap “Step-by-step solution” under it.

Practise this chapter online with instant answer checking: prepwiser.in/learn · No signup needed to browse

Derivatives of Standard Functions · 3 PYQs

Q1 JEE Main 2024 · 29 Jan · Shift 1

Suppose

$$f(x) = \frac{(2^x + 2^{-x}) \tan x \sqrt{\tan^{-1}(x^2 - x + 1)}}{(7x^2 + 3x + 1)^3}$$

. Then the value of $f'(0)$ is equal to

(A) π

(B) $\sqrt{\pi}$

(C) 0

(D) $\frac{\pi}{2}$

[Step-by-step solution ► prepwisar.in/questions/0D4h5PRXNi](https://www.prepwisar.in/questions/0D4h5PRXNi)

Q2 JEE Main 2024 · 27 Jan · Shift 1

Let for a differentiable function $f : (0, \infty) \rightarrow \mathbf{R}$, $f(x) - f(y) \geq \log_e \left(\frac{x}{y} \right) + x - y, \forall x, y \in (0, \infty)$. Then

$\sum_{n=1}^{20} f' \left(\frac{1}{n^2} \right)$ is equal to _____.

Numerical answer — enter the value.

[Step-by-step solution ► prepwisar.in/questions/af30CIBVKG](https://www.prepwisar.in/questions/af30CIBVKG)

Q3 JEE Main 2020 · 7 Jan · Shift 1

If

$$y(\alpha) = \sqrt{2 \left(\frac{\tan \alpha + \cot \alpha}{1 + \tan^2 \alpha} \right) + \frac{1}{\sin^2 \alpha}}, \alpha \in \left(\frac{3\pi}{4}, \pi \right)$$

$\frac{dy}{d\alpha}$ at $\alpha = \frac{5\pi}{6}$ is :

(A) 4

(B) -4

(C) $\frac{4}{3}$

(D) $-\frac{1}{4}$

[Step-by-step solution ► prepwisar.in/questions/kBouHP1p9K](https://www.prepwisar.in/questions/kBouHP1p9K)

Chain Rule · 7 PYQs

Q4 JEE Main 2024 · 1 Feb · Shift 2

If $y = \frac{(\sqrt{x+1})(x^2 - \sqrt{x})}{x\sqrt{x} + x + \sqrt{x}} + \frac{1}{15} (3 \cos^2 x - 5) \cos^3 x$, then $96y' \left(\frac{\pi}{6} \right)$ is equal to :

Numerical answer — enter the value.

[Step-by-step solution ► prepwisar.in/questions/g_IS9du5bQ](https://www.prepwisar.in/questions/g_IS9du5bQ)

Q5 JEE Main 2024 · 29 Jan · Shift 2

Let $y = \log_e \left(\frac{1-x^2}{1+x^2} \right)$, $-1 < x < 1$. Then at $x = \frac{1}{2}$, the value of $225(y' - y'')$ is equal to

(A) 732

(B) 736

(C) 742

(D) 746

[Step-by-step solution](#) ► [prepwiser.in/questions/IDn10MkfO7](https://www.prepwiser.in/questions/IDn10MkfO7)

Q6 JEE Main 2023 · 31 Jan · Shift 1

Let

$$y = f(x) = \sin^3 \left(\frac{\pi}{3} \left(\cos \left(\frac{\pi}{3\sqrt{2}} (-4x^3 + 5x^2 + 1)^{\frac{3}{2}} \right) \right) \right)$$

. Then, at $x = 1$,

(A) $2y' + \sqrt{3}\pi^2 y = 0$

(B) $y' + 3\pi^2 y = 0$

(C) $\sqrt{2}y' - 3\pi^2 y = 0$

(D) $2y' + 3\pi^2 y = 0$

[Step-by-step solution](#) ► [prepwiser.in/questions/myNIRK4i_I](https://www.prepwiser.in/questions/myNIRK4i_I)

Q7 JEE Main 2022 · 26 Jul · Shift 2

The value of $\log_e 2 \frac{d}{dx} (\log_{\cos x} \operatorname{cosec} x)$ at $x = \frac{\pi}{4}$ is

(A) $-2\sqrt{2}$

(B) $2\sqrt{2}$

(C) -4

(D) 4

[Step-by-step solution](#) ► [prepwiser.in/questions/F25NI50RoG](https://www.prepwiser.in/questions/F25NI50RoG)

Q8 JEE Main 2021 · 17 Mar · Shift 1

If

$$f(x) = \sin \left(\cos^{-1} \left(\frac{1-2^{2x}}{1+2^{2x}} \right) \right)$$

and its first derivative with respect to x is $-\frac{b}{a} \log_e 2$ when $x = 1$, where a and b are integers, then the minimum value of $|a^2 - b^2|$ is _____.

Numerical answer — enter the value.

[Step-by-step solution](#) ► [prepwiser.in/questions/ep5xfODW8f](https://www.prepwiser.in/questions/ep5xfODW8f)

Q9 JEE Main 2020 · 5 Sep · Shift 2

The derivative of

$\tan^{-1} \left(\frac{\sqrt{1+x^2}-1}{x} \right)$ with

respect to $\tan^{-1} \left(\frac{2x\sqrt{1-x^2}}{1-2x^2} \right)$ at $x = \frac{1}{2}$ is :

(A) $\frac{2\sqrt{3}}{3}$

(B) $\frac{2\sqrt{3}}{5}$

(C) $\frac{\sqrt{3}}{10}$

(D) $\frac{\sqrt{3}}{12}$

[Step-by-step solution](#) ► [prepwiser.in/questions/08tkIcIfgQ](https://www.prepwiser.in/questions/08tkIcIfgQ)

Q10 JEE Main 2020 · 9 Jan · Shift 2

Let f and g be differentiable functions on $\mathbb{R}$ such that fg is the identity function. If for some $a, b \in \mathbb{R}$, $g'(a) = 5$ and $g(a) = b$, then $f'(b)$ is equal to :

- (A) 1 (B) 5
(C) $\frac{2}{5}$ (D) $\frac{1}{5}$

Step-by-step solution ► [prepwisser.in/questions/5m8tjpU1kD](https://www.prepwisser.in/questions/5m8tjpU1kD)

Implicit Differentiation · 8 PYQs

Q11 JEE Main 2023 · 6 Apr · Shift 1

If $2x^y + 3y^x = 20$, then $\frac{dy}{dx}$ at $(2, 2)$ is equal to :

- (A) $-\left(\frac{3+\log_e 16}{4+\log_e 8}\right)$
(B) $-\left(\frac{2+\log_e 8}{3+\log_e 4}\right)$
(C) $-\left(\frac{3+\log_e 8}{2+\log_e 4}\right)$
(D) $-\left(\frac{3+\log_e 4}{2+\log_e 8}\right)$

Step-by-step solution ► [prepwisser.in/questions/9yuoBLwjYd](https://www.prepwisser.in/questions/9yuoBLwjYd)

Q12 JEE Main 2022 · 27 Jul · Shift 2

For the curve $C : (x^2 + y^2 - 3) + (x^2 - y^2 - 1)^5 = 0$, the value of $3y' - y^3y''$, at the point (α, α) , $\alpha > 0$, on C , is equal to _____.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisser.in/questions/OEKnrXXUkj](https://www.prepwisser.in/questions/OEKnrXXUkj)

Q13 JEE Main 2021 · 26 Aug · Shift 1

If $y = y(x)$ is an implicit function of x such that $\log_e(x + y) = 4xy$, then $\frac{d^2y}{dx^2}$ at $x = 0$ is equal to _____.

Numerical answer — enter the value.

Step-by-step solution ► [prepwisser.in/questions/gD9VEf2Oe7](https://www.prepwisser.in/questions/gD9VEf2Oe7)

Q14 JEE Main 2020 · 4 Sep · Shift 1

If

$$(a + \sqrt{2}b \cos x)(a - \sqrt{2}b \cos y) = a^2 - b^2$$

where $a > b > 0$, then $\frac{dx}{dy}$ at $(\frac{\pi}{4}, \frac{\pi}{4})$ is :

- (A) $\frac{a-2b}{a+2b}$ (B) $\frac{a-b}{a+b}$
(C) $\frac{a+b}{a-b}$ (D) $\frac{2a+b}{2a-b}$

Step-by-step solution ► [prepwisser.in/questions/puaJFpY7OM](https://www.prepwisser.in/questions/puaJFpY7OM)

Q15 JEE Main 2020 · 4 Sep · Shift 2

Let $f : (0, \infty) \rightarrow (0, \infty)$ be a differentiable function such that $f(1) = e$ and

$$\lim_{t \rightarrow x} \frac{t^2 f^2(x) - x^2 f^2(t)}{t - x} = 0$$

. If $f(x) = 1$, then x is equal to :

- (A) $\frac{1}{e}$ (B) e
(C) $\frac{1}{2e}$ (D) $2e$

[Step-by-step solution ► prepwisar.in/questions/o6E1nf-j9g](https://www.prepwisar.in/questions/o6E1nf-j9g)

Q16 JEE Main 2020 · 3 Sep · Shift 1

If $y^2 + \log_e(\cos^2 x) = y$,

$x \in (-\frac{\pi}{2}, \frac{\pi}{2})$, then :

- (A) $|y''(0)| = 2$ (B) $|y'(0)| + |y''(0)| = 3$
(C) $y''(0) = 0$ (D) $|y'(0)| + |y''(0)| = 1$

[Step-by-step solution ► prepwisar.in/questions/5M8VxdoczC](https://www.prepwisar.in/questions/5M8VxdoczC)

Q17 JEE Main 2020 · 7 Jan · Shift 1

Let $x^k + y^k = a^k$, ($a, k > 0$) and $\frac{dy}{dx} + (\frac{y}{x})^{\frac{1}{3}} = 0$, then k is:

- (A) $\frac{1}{3}$ (B) $\frac{2}{3}$
(C) $\frac{4}{3}$ (D) $\frac{3}{2}$

[Step-by-step solution ► prepwisar.in/questions/Ch61x_mwrv](https://www.prepwisar.in/questions/Ch61x_mwrv)

Q18 JEE Main 2020 · 7 Jan · Shift 2

Let $y = y(x)$ be a function of x satisfying

$y\sqrt{1-x^2} = k - x\sqrt{1-y^2}$ where k is a constant and

$y(\frac{1}{2}) = -\frac{1}{4}$. Then $\frac{dy}{dx}$ at $x = \frac{1}{2}$, is equal to :

- (A) $\frac{2}{\sqrt{5}}$ (B) $-\frac{\sqrt{5}}{2}$
(C) $\frac{\sqrt{5}}{2}$ (D) $-\frac{\sqrt{5}}{4}$

[Step-by-step solution ► prepwisar.in/questions/Ex1pWZbgh6](https://www.prepwisar.in/questions/Ex1pWZbgh6)

Higher Order Derivatives · 11 PYQs

Q19 JEE Main 2024 · 9 Apr · Shift 1

Let $f(x) = ax^3 + bx^2 + cx + 41$ be such that $f(1) = 40$, $f'(1) = 2$ and $f''(1) = 4$. Then $a^2 + b^2 + c^2$ is equal to:

- (A) 54 (B) 51
(C) 73 (D) 62

[Step-by-step solution ► prepwisar.in/questions/3_DYOp9Cx7](https://www.prepwisar.in/questions/3_DYOp9Cx7)

Q20 JEE Main 2024 · 9 Apr · Shift 2

If $\log_e y = 3 \sin^{-1} x$, then $(1 - x^2)y'' - xy'$ at $x = \frac{1}{2}$ is equal to

- (A) $9e^{\pi/2}$ (B) $9e^{\pi/6}$
(C) $3e^{\pi/2}$ (D) $3e^{\pi/6}$

[Step-by-step solution](#) ► [prepwisar.in/questions/ad0_n6HEvn](https://www.prepwisar.in/questions/ad0_n6HEvn)

Q21 JEE Main 2024 · 5 Apr · Shift 2

If

$$y(\theta) = \frac{2 \cos \theta + \cos 2\theta}{\cos 3\theta + 4 \cos 2\theta + 5 \cos \theta + 2}$$

, then at $\theta = \frac{\pi}{2}$, $y'' + y' + y$ is equal to :

- (A) $\frac{1}{2}$ (B) 1
(C) $\frac{3}{2}$ (D) 2

[Step-by-step solution](#) ► [prepwisar.in/questions/axH9CVmB0s](https://www.prepwisar.in/questions/axH9CVmB0s)

Q22 JEE Main 2024 · 27 Jan · Shift 1

Let $f(x) = x^3 + x^2 f'(1) + x f''(2) + f'''(3)$, $x \in \mathbf{R}$. Then $f'(10)$ is equal to _____.

Numerical answer — enter the value.

[Step-by-step solution](#) ► [prepwisar.in/questions/PWKg23ZcoV](https://www.prepwisar.in/questions/PWKg23ZcoV)

Q23 JEE Main 2023 · 8 Apr · Shift 1

Let

$$f(x) = \frac{\sin x + \cos x - \sqrt{2}}{\sin x - \cos x}, x \in [0, \pi] - \left\{ \frac{\pi}{4} \right\}$$

. Then $f\left(\frac{7\pi}{12}\right) f''\left(\frac{7\pi}{12}\right)$ is equal to

- (A) $\frac{2}{3\sqrt{3}}$ (B) $\frac{2}{9}$
(C) $\frac{-1}{3\sqrt{3}}$ (D) $\frac{-2}{3}$

[Step-by-step solution](#) ► [prepwisar.in/questions/waB7Ql4GmT](https://www.prepwisar.in/questions/waB7Ql4GmT)

Q24 JEE Main 2023 · 1 Feb · Shift 1

If $f(x) = x^2 + g'(1)x + g''(2)$ and $g(x) = f(1)x^2 + x f'(x) + f''(x)$, then the value of $f(4) - g(4)$ is equal to _____.

Numerical answer — enter the value.

[Step-by-step solution](#) ► [prepwisar.in/questions/W7Cg-68qtD](https://www.prepwisar.in/questions/W7Cg-68qtD)

Q25 JEE Main 2023 · 1 Feb · Shift 2

If $y(x) = x^x$, $x > 0$, then $y''(2) - 2y'(2)$ is equal to

- (A) $4(\log_e 2)^2 + 2$ (B) $8 \log_e 2 - 2$
(C) $4 \log_e 2 + 2$ (D) $4(\log_e 2)^2 - 2$

[Step-by-step solution](#) ► [prepwisar.in/questions/JZSmEhC8C6](https://www.prepwisar.in/questions/JZSmEhC8C6)

Q26 JEE Main 2023 · 25 Jan · Shift 1

Let $y(x) = (1+x)(1+x^2)(1+x^4)(1+x^8)(1+x^{16})$. Then $y' - y''$ at $x = -1$ is equal to

- (A) 496 (B) 976
(C) 464 (D) 944

[Step-by-step solution](#) ► [prepwiser.in/questions/7Posb3vQ7B](https://www.prepwiser.in/questions/7Posb3vQ7B)

Q27 JEE Main 2023 · 24 Jan · Shift 2

If $f(x) = x^3 - x^2 f'(1) + x f''(2) - f'''(3)$, $x \in \mathbb{R}$, then

- (A) $2f(0) - f(1) + f(3) = f(2)$ (B) $f(1) + f(2) + f(3) = f(0)$
(C) $f(3) - f(2) = f(1)$ (D) $3f(1) + f(2) = f(3)$

[Step-by-step solution](#) ► [prepwiser.in/questions/O_gtr6tSbO](https://www.prepwiser.in/questions/O_gtr6tSbO)

Q28 JEE Main 2022 · 27 Jun · Shift 2

If $y(x) = (x^x)^x$, $x > 0$, then $\frac{d^2 y}{dx^2} + 20$ at $x = 1$ is equal to _____.

Numerical answer — enter the value.

[Step-by-step solution](#) ► [prepwiser.in/questions/jDuNYY-f2r](https://www.prepwiser.in/questions/jDuNYY-f2r)

Q29 JEE Main 2021 · 16 Mar · Shift 2

Let $f : S \rightarrow S$ where $S = (0, \infty)$ be a twice differentiable function such that $f(x+1) = xf(x)$. If $g : S \rightarrow \mathbb{R}$ be defined as $g(x) = \log_e f(x)$, then the value of $|g''(5) - g''(1)|$ is equal to :

- (A) 1 (B) $\frac{187}{144}$
(C) $\frac{197}{144}$ (D) $\frac{205}{144}$

[Step-by-step solution](#) ► [prepwiser.in/questions/_y70i_z10u](https://www.prepwiser.in/questions/_y70i_z10u)

Parametric Differentiation · 3 PYQs

Q30 JEE Main 2022 · 28 Jul · Shift 2

Let $x(t) = 2\sqrt{2} \cos t \sqrt{\sin 2t}$ and

$y(t) = 2\sqrt{2} \sin t \sqrt{\sin 2t}$, $t \in (0, \frac{\pi}{2})$.

Then $\frac{1 + \left(\frac{dy}{dx}\right)^2}{\frac{d^2 y}{dx^2}}$ at $t = \frac{\pi}{4}$ is equal to :

- (A) $\frac{-2\sqrt{2}}{3}$ (B) $\frac{2}{3}$
(C) $\frac{1}{3}$ (D) $\frac{-2}{3}$

[Step-by-step solution](#) ► [prepwiser.in/questions/elw-Hd4_69](https://www.prepwiser.in/questions/elw-Hd4_69)

Q31 JEE Main 2022 · 25 Jun · Shift 2

If the angle made by the tangent at the point (x_0, y_0) on the curve $x = 12(t + \sin t \cos t)$, $y = 12(1 + \sin t)^2$, $0 < t < \frac{\pi}{2}$, with the positive x-axis is $\frac{\pi}{3}$, then y_0 is equal to:

- (A) $6(3 + 2\sqrt{2})$ (B) $3(7 + 4\sqrt{3})$
(C) 27 (D) 48

[Step-by-step solution](#) ► [prepwiser.in/questions/5vHM41DhXw](https://www.prepwiser.in/questions/5vHM41DhXw)

Q32 JEE Main 2020 · 9 Jan · Shift 2

If $x = 2 \sin \theta - \sin 2\theta$ and $y = 2 \cos \theta - \cos 2\theta$,
 $\theta \in [0, 2\pi]$, then $\frac{d^2y}{dx^2}$ at $\theta = \pi$ is :

(A) $\frac{3}{8}$

(B) $\frac{3}{2}$

(C) $\frac{3}{4}$

(D) $-\frac{3}{4}$

[Step-by-step solution ► prepwisser.in/questions/KypjkvmJt7](https://www.prepwisser.in/questions/KypjkvmJt7)

Product and Quotient Rule · 1 PYQs

Q33 JEE Main 2024 · 6 Apr · Shift 2

Suppose for a differentiable function h , $h(0) = 0$, $h(1) = 1$ and $h'(0) = h'(1) = 2$. If $g(x) = h(e^x) e^{h(x)}$, then $g'(0)$ is equal to:

(A) 4

(B) 5

(C) 3

(D) 8

[Step-by-step solution ► prepwisser.in/questions/rvhYKr4Gor](https://www.prepwisser.in/questions/rvhYKr4Gor)

Answer key — Differentiation

Numbers match the question numbers above. For full working, open the solution link under each question.

1	B	2	2890	3	A	4	105	5	B	6	D	7	D	8	481
9	C	10	D	11	B	12	16	13	40	14	C	15	A	16	A
17	B	18	B	19	B	20	A	21	D	22	202	23	B	24	14
25	D	26	A	27	A	28	16	29	D	30	D	31	C	32	A
33	A														

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