MATHEMATICS · GRADES 10-12

Higher-order derivatives

Difficulty level: Advanced

Mathematics: Grades 10-12

This document was made by AI and there may be mistakes. If a question or answer looks wrong, use the Flag a mistake button to let Brett know so he can fix it.

Overview of the concept

This is how you track how a rate of change is itself changing, like a car speeding up faster and faster as you press the pedal. The first rate tells you how fast you are going, the next one tells you how fast that speed is changing, and each step deeper tells you more about how the motion is evolving. Engineers use this to design smooth rides and safe braking, and physicists use it to describe how an object accelerates and how that acceleration itself changes.



Rule

Higher-order derivatives: the second derivative is the derivative of the first derivative, and each higher derivative is the derivative of the one before it.

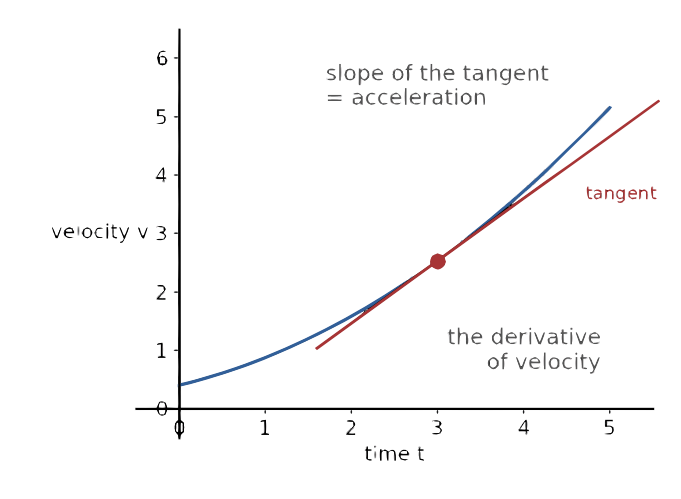
In motion, the second derivative is acceleration.

© 2026 Brett Robbins. All Rights Reserved.

Worked examples

EXAMPLE 1

Q Find the second derivative of x^3.



SOLUTION

First derivative: $3x^2$

Differentiate again: $6x$

So the second derivative is $6x$

EXAMPLE 2

Q Find the second derivative of $x^2 + 3x$.

SOLUTION

First derivative: $2x + 3$

Differentiate again: 2

So the second derivative is 2, a constant.

© 2026 Brett Robbins. All Rights Reserved.

Practice questions

1 What is the second derivative of x^4?

- **A** $4x^3$
- **B** $12x^2$
- **C** $12x$
- **D** $4x^2$

Understand It with Pulse | Flag a mistake

2 What is the second derivative of $2x^2$?

Understand It with Pulse | Flag a mistake

© 2026 Brett Robbins. All Rights Reserved.

3 Differentiate $x^3 + x$ twice. What do you get?

- **A** $3x^2$
- **B** $6x^2$
- **C** $6x$
- **D** $3x$

Understand It with Pulse | Flag a mistake

4 What is the second derivative called in motion?

- **A** Acceleration
- **B** Velocity
- **C** Speed
- **D** Jerk

Understand It with Pulse | Flag a mistake

© 2026 Brett Robbins. All Rights Reserved.

5 Find the third derivative of x^4

- **A** $12x^2$
- **B** $24x^2$
- **C** $4x^3$
- **D** $24x$

Understand It with Pulse | Flag a mistake

6 What is the second derivative of $5x$?

Understand It with Pulse | Flag a mistake

7 The position of a car is $s = t^3$. What is its acceleration when $t = 2$?

Understand It with Pulse | Flag a mistake

© 2026 Brett Robbins. All Rights Reserved.

8 Which notation means the second derivative?

A f'(x)

B f''(x)

C f'''(x)

D f(x)

Understand It with Pulse | Flag a mistake

9 What is the second derivative of $3x^3$?

A $9x^2$

B $18x^2$

C $18x$

D $6x^3$

Understand It with Pulse | Flag a mistake

© 2026 Brett Robbins. All Rights Reserved.

10 **Differentiate sin x twice. What do you get?**

A sin x

B cos x

C -sin x

D -cos x

Understand It with Pulse | Flag a mistake

© 2026 Brett Robbins. All Rights Reserved.

ANSWER KEY

1. $12x^2$

2. 4

3. 6x

4. Acceleration

5. 24x

6. 0

7. 12

8. f''(x)

9. 18x

10. -sin x

© 2026 Brett Robbins. All Rights Reserved.