

Exercise walk-through

3.6

Calculating Higher-Order Derivatives

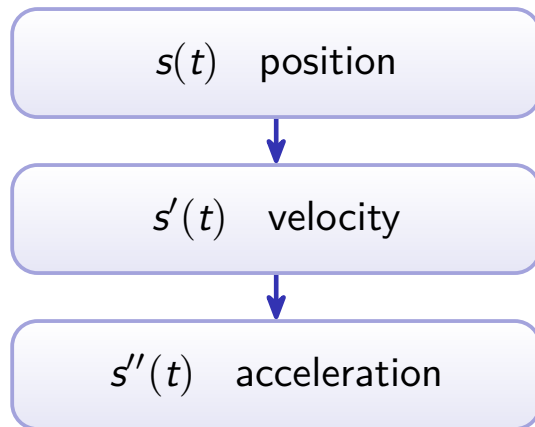
AP Calculus BC

Higher-order derivatives

Differentiating f' gives the **second derivative** f'' :

$$f''(x) = \frac{d^2 y}{dx^2} = y'', \quad f^{(n)}(x) = \frac{d^n y}{dx^n}.$$

f'' measures how the **slope** is changing
– it drives **concavity** (Unit 5)
and acceleration (Unit 4).



Choosing the right rule

Read the structure **from the outside in**: name the outermost operation, apply its rule, recurse inward.

a **sum**?
differentiate term by term

a **product** / **quotient**?
that rule (chain inside)

a **composite**?
chain rule

given **implicitly**?
implicit differentiation

Neatness prevents the sign and bookkeeping errors that cost the marks.

Exercises 2.1-2.3

2.1 State what the second derivative is.

[1]

2.2 For $f(x) = x^3$, find f'' .

[2]

2.3 State the notation for the second derivative.

[1]

Exercises 2.1-2.3

2.1 State what the second derivative is. [1]

2.1

- the derivative of the first derivative
-

2.2 For $f(x) = x^3$, find f'' . [2]

2.2

- $f' = 3x^2$, so $f'' = 6x$
-

2.3 State the notation for the second derivative. [1]

2.3

- $f''(x)$ or $\frac{d^2y}{dx^2}$

Exercises 3.1-3.2

3.1 The second derivative is the derivative of

[1]

☐

A f

B f'

C the integral

D a constant

3.2 $\frac{d^2y}{dx^2}$ denotes the

[1]

☐

A first derivative

B second derivative

C integral

D slope only

Exercises 3.1-3.2

3.1 The second derivative is the derivative of

[1]

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A f

B f'

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3.1 B

- f' .

3.2 $\frac{d^2y}{dx^2}$ denotes the

[1]

☐

A first derivative

B second derivative

C integral

D slope only

3.2 B

- second derivative.

Exercise 3.3 (a)

3.3 $f(x) = x^4$.

(a) Find f' .

[1]

Exercise 3.3 (a)

3.3 $f(x) = x^4$.

(a) Find f' .

[1]

(a)

- $4x^3$

Exercise 3.3 (b)

3.3 $f(x) = x^4$.

(b) Find f'' .

[1]

Exercise 3.3 (b)

3.3 $f(x) = x^4$.

(b) Find f'' .

[1]

(b)

- $12x^2$

Exercise 3.3 (c)

3.3 $f(x) = x^4$.

(c) State $f''(1)$.

[1]

Exercise 3.3 (c)

3.3 $f(x) = x^4$.

(c) State $f''(1)$.

[1]

(c)

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