MATHEMATICS · GRADES 10-12

# Antiderivatives

### Difficulty level: Advanced

### Mathematics: Grades 10-12

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## *Overview of the concept*

This is how you work backwards from a speed reading to find how far you have travelled. A speedometer tells you how fast you are going right now, but the distance you covered is the total that built up over the whole trip. Antiderivatives turn a rate of change back into the total amount, which is how engineers and scientists recover totals from rates.




## *Rule*

### Antiderivatives: an antiderivative undoes differentiation.

The antiderivative of $x^n$ is $\frac{x^{(n+1)}}{(n+1)} + C$, because differentiating it gives back $x^n$. The C stands for any constant, since the derivative of a constant is zero.

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## Worked examples

EXAMPLE 1

### Q Find the antiderivative of 2x.

**SOLUTION**

We need a function that differentiates to 2x.

$x^2$ differentiates to 2x.

So the antiderivative is $x^2 + C$, where C is any constant.

EXAMPLE 2

### Q Find the antiderivative of 3.

**SOLUTION**

We need a function that differentiates to 3.

3x differentiates to 3.

So the antiderivative is 3x + C

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## Practice questions

**1** What function has derivative 0, up to a constant?

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

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**2** What function has derivative 1?

- **A** $2x + C$
- **B** $x^2 + C$
- **C** $x + C$
- **D** $C$

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## 3 What function has derivative $2x^2$?

A $x^3 + C$

B $2x^3 + C$

C $\frac{2}{3}x^3 + C$

D $\frac{1}{3}x^3 + C$

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## 4 An antiderivative is written with + C. What can C be?

A Only 0

B Any positive number

C Any constant

D Any number except 0

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## 5 What function has derivative 4x?

A $2x^2 + C$

B $x^2 + C$

C $4x^2 + C$

D $2x + C$

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## 6 What is the derivative of $x^3 + C$?

A $3x^2$

B $x^3$

C $3x$

D $C$

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## 7 What function has derivative x?

A $x^2 + C$

B $\frac{x^2}{2} + C$

C $2x^2 + C$

D $x + C$

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## 8 Why does every antiderivative include a + C?

A Because C is always 0

B Because the derivative of a constant is 0

C Because every function has the same derivative

D Because the derivative of x is 1

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## 9 What function has derivative $6x^2$?

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

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## 10 What function has derivative $2x + 3$?

- A $x^2 + 3x + C$
- B $2x^2 + 3x + C$
- C $x^2 + 3 + C$
- D $2x + 3x^2 + C$

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## ANSWER KEY

**1.** C

**2.** $x + C$

**3.** $\frac{2}{3}\ x^3 + C$

**4.** Any constant

**5.** $2x^2 + C$

**6.** $3x^2$

**7.** $\frac{x^2}{2} + C$

**8.** Because the derivative of a constant is 0

**9.** $2x^3 + C$

**10.** $x^2 + 3x + C$

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