MATHEMATICS · GRADES 10-12

Basic integration rules

Difficulty level: Advanced

Mathematics: Grades 10-12

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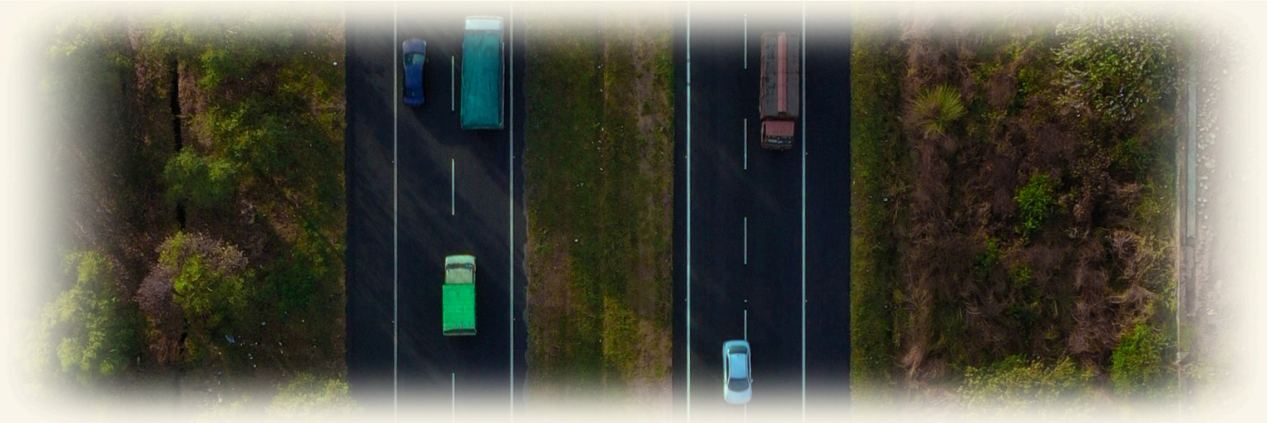
Overview of the concept

This is how you add up many tiny pieces to find a total, like the distance covered from a speed reading over a whole trip. You work with each power one at a time, which keeps a hard total manageable. It is the reverse of differentiation, and it is how totals are recovered from rates in physics and engineering.



Rule

Basic integration rules: integrate term by term.

The integral of x^n is $\frac{x^{(n+1)}}{(n+1)} + C$, and the integral of a constant is $c \times x + C$. The answer is called the antiderivative, because it undoes differentiation. The + C stands for any constant number, because differentiating any constant gives 0.

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Worked examples

EXAMPLE 1

Q Integrate x^2.

SOLUTION

Raise the power by one: x^3.

Divide by the new power: $\frac{x^3}{3}$.

So the answer is $\frac{x^3}{3} + C$.

EXAMPLE 2

Q Integrate $2x + 1$.

SOLUTION

Integrate term by term: $2x$ gives x^2, 1 gives x.

$x^2 + x$

So the answer is $x^2 + x + C$.

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Practice questions

1 Integrate x^2

- **A** $\frac{x^2}{2} + C$
- **B** $\frac{x^3}{3} + C$
- **C** $3x^2 + C$
- **D** $\frac{x^4}{4} + C$

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2 Integrate x^3

- **A** $\frac{x^3}{3} + C$
- **B** $4x^3 + C$
- **C** $\frac{x^4}{4} + C$
- **D** $\frac{x^5}{5} + C$

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3 A car's velocity is $3x^2$ metres per second. Find its displacement as a function of x.

- **A** $3x^2 + C$
- **B** $x^3 + C$
- **C** $x^2 + C$
- **D** $\frac{x^4}{4} + C$

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4 Water flows at $5x^4$ litres per minute. How much water has flowed, as a function of x?

- **A** $5x^4 + C$
- **B** $x^4 + C$
- **C** $x^5 + C$
- **D** $\frac{x^6}{6} + C$

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5 Find the antiderivative of $2x + 1$

A $x^2 + x + C$

B $2x + 1 + C$

C $x^2 - x + C$

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

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6 Find the antiderivative of $x^2 + x$.

A $x^3 \div 3 + x^2 \div 2 + C$

B $x^3 \div 3 - x^2 \div 2 + C$

C $x^3 \div 3 + x^2 + C$

D $2x + 1 + C$

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7 A ball's velocity is $3x^2 + 2x$ metres per second. Find its displacement as a function of x.

- **A** $3x^2 + 2x + C$
- **B** $x^3 + x^2 + C$
- **C** $x^3 - x^2 + C$
- **D** $\frac{x^4}{4} + \frac{x^3}{3} + C$

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8 Integrate $2x$.

- **A** $2x + C$
- **B** $x^2 + C$
- **C** $\frac{x^3}{3} + C$
- **D** $2x^2 + C$

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9 Sand falls at a rate of $4x + 3$ kilograms per second. How much sand has fallen, as a function of x?

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

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10 Find the antiderivative of x^4

- **A** $\frac{x^4}{4} + C$
- **B** $5x^4 + C$
- **C** $x^5 \div 5 + C$
- **D** $\frac{x^6}{6} + C$

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ANSWER KEY

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

2. $\frac{x^4}{4} + C$

3. $x^3 + C$

4. $x^5 + C$

5. $x^2 + x + C$

6. $x^3 \div 3 + x^2 \div 2 + C$

7. $x^3 + x^2 + C$

8. $x^2 + C$

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

10. $x^5 \div 5 + C$

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