

# 6 Integration and the power rule – Part 2

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

## Recall

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In Part A you saw that the integral is the exact area under a curve. Now compute it:

- Integration is the **reverse** of differentiation.
- There is a simple rule for powers of  $x$ , just like the power rule for derivatives.

Each idea has a worked example before the Practice.

## New ideas

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### ■ 1 Integration undoes differentiation

**Integration** finds a function whose derivative is the one you started with – it is the reverse of differentiating. This reverse is written with the sign  $\int$ .

### ■ 2 The power rule for integration

To integrate a power of  $x$ , **raise the power by one and divide by the new power**:

$$\int x^n dx = \frac{x^{n+1}}{n+1} + C.$$

*Worked example.*  $\int x^2 dx = \frac{x^3}{3} + C$  (check: differentiating  $\frac{x^3}{3}$  gives  $x^2$ ).

### ■ 3 The “+ C”

Because many functions share the same derivative (they differ by a constant), we add a constant  $C$  when integrating.

### ■ 4 Definite integral gives area

A **definite integral** (with limits) gives the exact area under the curve between two  $x$ -values.

*Worked example.* The area under  $y = x$  from 0 to 2 is  $\left[\frac{x^2}{2}\right]_0^2 = \frac{4}{2} - 0 = 2$ .

**Watch out:** integration **raises** the power and **divides** – the exact opposite of differentiation, which lowers the power and multiplies. Mixing them up is a common slip.

## Practice

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Try these in order. The methods are all above.

**2.1** State how integration relates to differentiation. [1]

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**2.2** Find  $\int x^3 dx$ . [2]

**2.3** Find  $\int x^4 dx$ . [2]

**2.4** State why we add "+C" when integrating. [2]

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**2.5** Find the area under  $y = x$  from 0 to 4 using  $\left[\frac{x^2}{2}\right]_0^4$ . [3]