

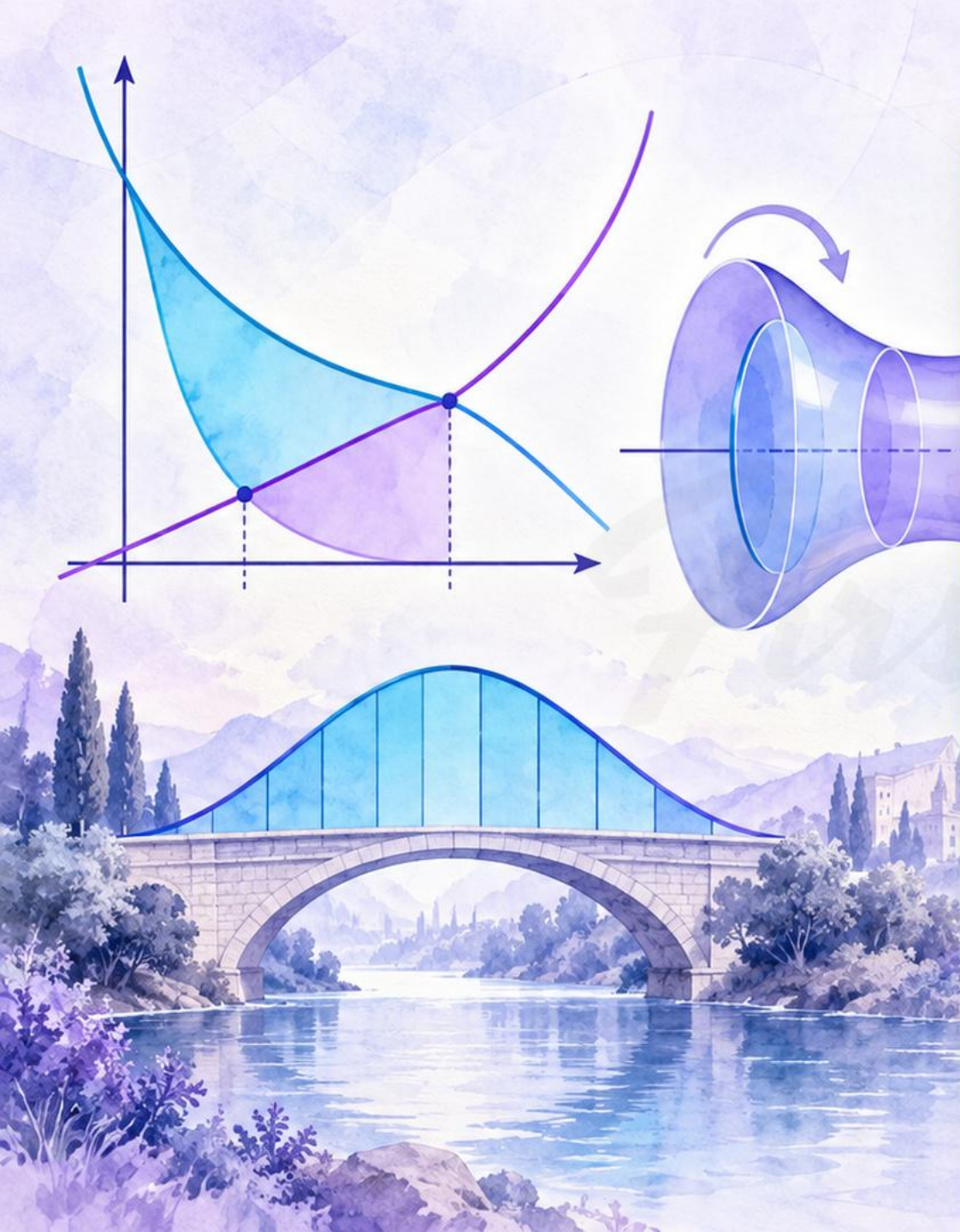
MATHEMATICS • CLASS 12

8

CHAPTER

Applications of Integrals

CHAPTER NOTES



AREA WITH VERTICAL STRIPS

Simple geometry gives areas of familiar shapes.
Integration also finds areas bounded by curves.

Imagine the region divided into many very thin vertical strips.

Each strip has height given by the curve and a very small width.

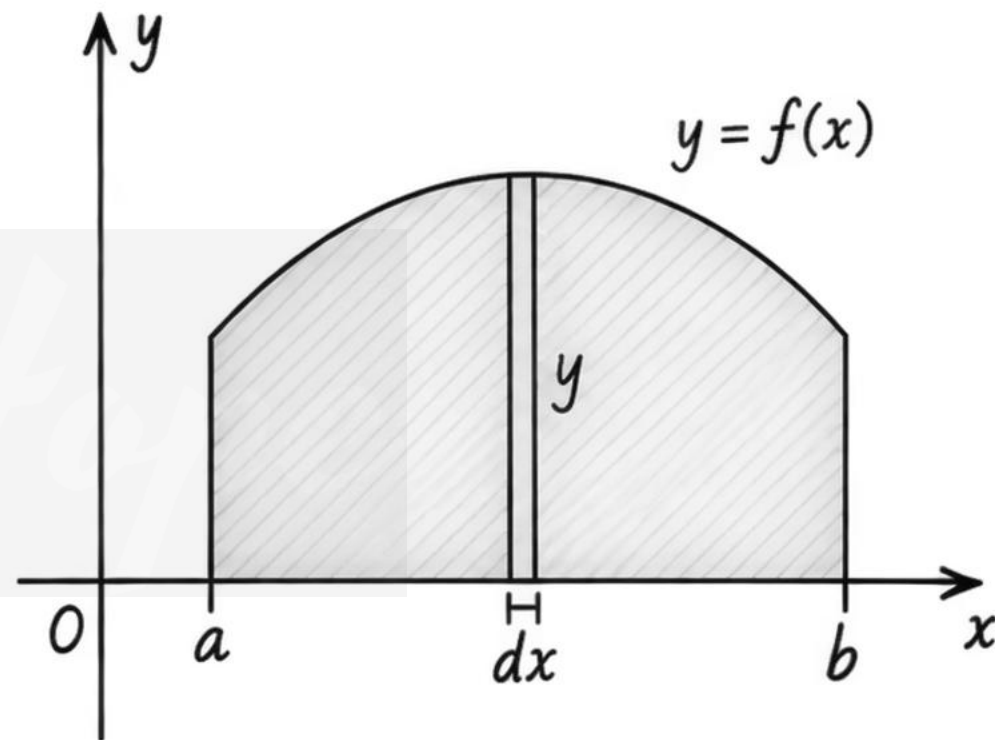
$y = f(x)$, $a < b$, $f(x) \geq 0$ on $[a, b]$.

$$dA = y \, dx.$$

$$A = \int_a^b y \, dx = \int_a^b f(x) \, dx.$$

Add the elementary areas over the whole interval.

Area unit: square units.



AREA WITH HORIZONTAL STRIPS

Use horizontal strips when the curve is easier to write as a horizontal distance.

Each strip extends from the vertical axis to the curve.

$$x = g(y), \quad c < d, \quad g(y) \geq 0 \text{ on } [c, d].$$

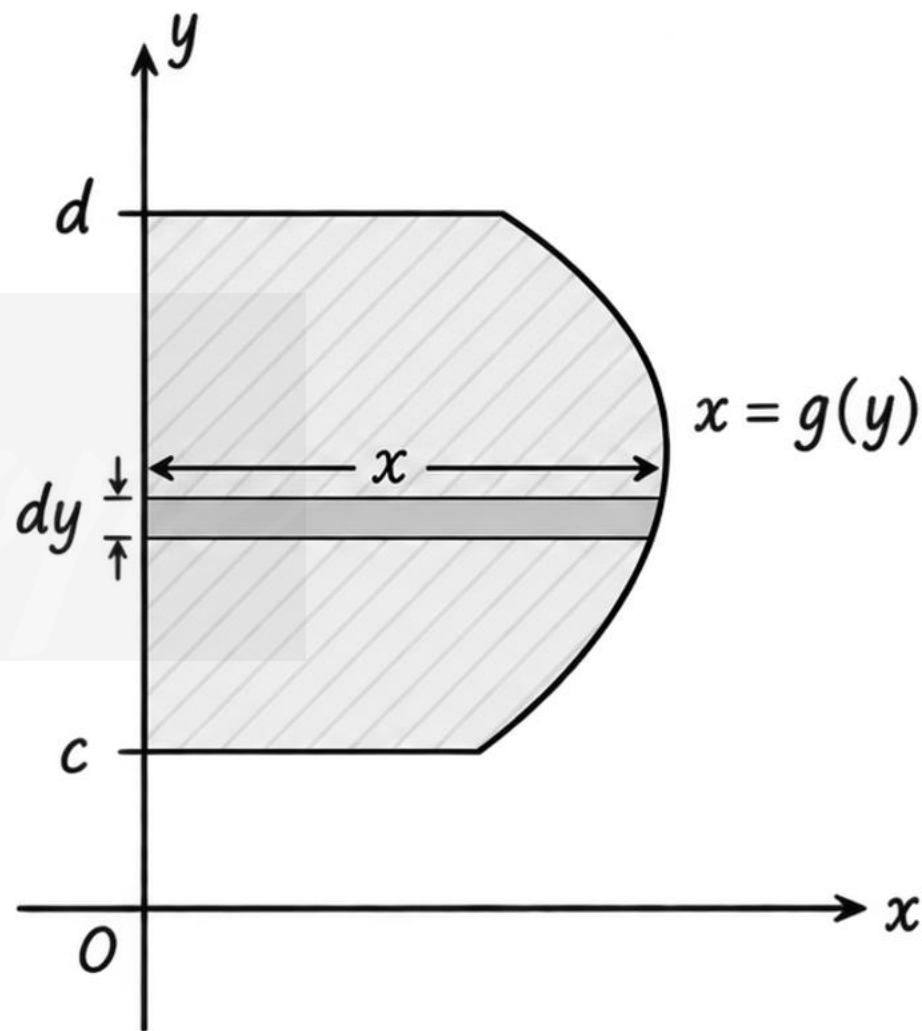
$$dA = x \, dy.$$

$$A = \int_c^d x \, dy = \int_c^d g(y) \, dy.$$

The limits now describe the vertical range.

Choose the strip direction that makes the calculation simpler.

Area unit: square units.



SIGNED INTEGRAL AND GEOMETRIC AREA

A definite integral gives signed contributions. Geometric area is always nonnegative.

$$a < b$$

Above the axis

$$f(x) \geq 0 \Rightarrow A = \int_a^b f(x) dx$$

Below the axis

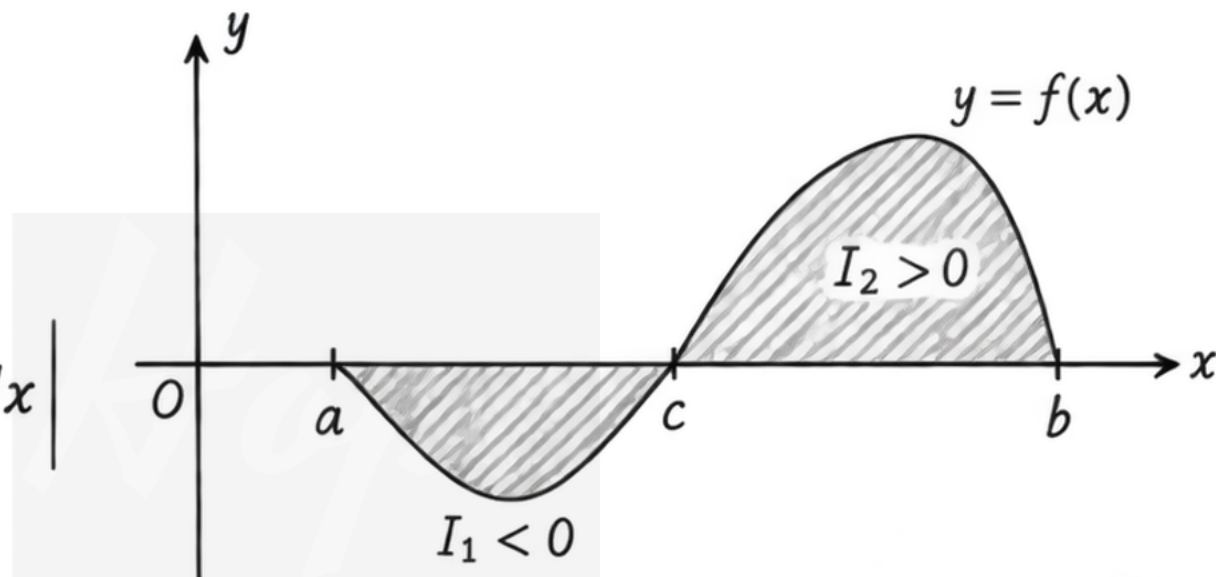
$$f(x) \leq 0 \Rightarrow A = -\int_a^b f(x) dx = \left| \int_a^b f(x) dx \right|$$

When the curve crosses the axis

$$f(x) \leq 0 \text{ on } [a, c], \quad f(x) \geq 0 \text{ on } [c, b]$$

$$A = -\int_a^c f(x) dx + \int_c^b f(x) dx$$

$$A = \int_a^b |f(x)| dx$$



Split at every sign change and add the positive areas. Do not take the absolute value of the total signed integral when parts lie on opposite sides.



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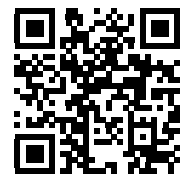


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