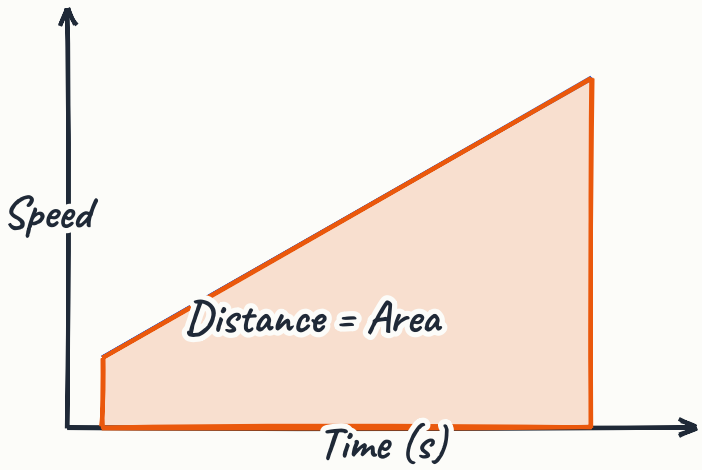
STUDY NOTES

explain integeration

Class 9-10

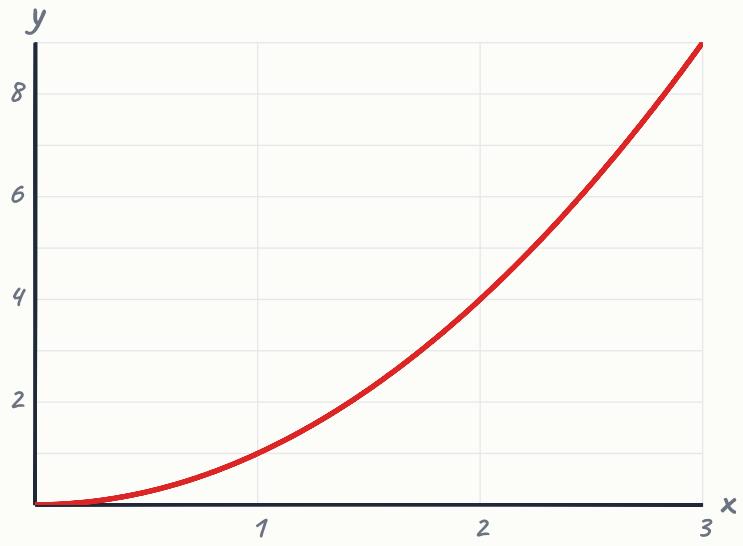


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1 Part 1

What if you could find the area under any curve — that is the magic of integration. Let us start by drawing a simple curve and the area we want to find beneath it. The shaded region between the curve and the x-axis is exactly what integration measures. Before integration, people tried to estimate this area using thin rectangles underneath the curve.



2 More rectangles → more accurate area

The more rectangles you use, the closer you get to the true area under the curve. Integration is the limit of this process — infinitely many infinitely thin rectangles. We write integration using this special elongated S symbol, called the integral sign. The integral sign means sum, x squared is the function, and d x means a tiny strip of width.

$$\int x^2 \, dx$$

- Integration = limit of infinite rectangles
- dx = infinitely thin width strip

3 C = constant of integration (unknown shift)

The general power rule for integration says: raise the power by one, then divide by the new power. Here n is the original power, n plus one is the new power, and C is the constant of integration. Let us work through a simple example: integrate x squared with respect to x. The power is 2, so we add 1 to get 3, giving us x cubed on top.

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

$$\int x^2 \, dx$$

$$= \frac{x^{2+1}}{2+1} + C$$

4 Part 4

Simplifying, two plus one is three, so the answer is x cubed over three plus C. Now let us find a definite integral — the actual area between x equals 1 and x equals 3. We substitute the limits: plug in 3 first, then subtract the result when we plug in 1. Three cubed is 27, so 27 over 3 is 9, and 1 over 3 stays as one third.

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

$$\int_1^3 x^2 \, dx$$

$$= \left[\frac{x^3}{3}\right]_1^3 = \frac{3^3}{3} - \frac{1^3}{3}$$

$$= 9 - \frac{1}{3} = \frac{26}{3}$$

5 Area = 26/3 ≈ 8.67 sq units

So the exact area under x squared from 1 to 3 is twenty-six thirds, roughly 8.67 square units. A very common mistake: students forget to add C when there are no limits given. In real life, engineers use integration to find the distance a car travels from its speed-time graph. The area under the speed-time graph — found by integration — gives the total distance travelled.

$$\int x^2 \, dx = \frac{x^3}{3} \quad \times \quad \text{Missing } C!$$

- Speed × Time = Distance = integral

6 ∫xⁿ dx = xⁿ⁺¹/(n+1) + C

Now your turn: what is the integral of x cubed with respect to x? Integration finds the area under a curve by summing infinite thin strips using the power rule.

Quick quiz

1. What is $\int x^3 \, dx$?
   - **a.** $x^4 + C$
   - **b.** $x^4 / 4 + C$
   - **c.** $3x^2 + C$
   - **d.** $x^4 / 3 + C$

Answer key

Quick quiz

1. **(b) x^4 / 4 + C** — Add 1 to the power (3+1=4) then divide by the new power 4, giving $x^4/4$ + C.