

Substitution Method — Summary

Solve a pair of linear equations in two variables by replacing one variable with an expression in the other.

Isolate one variable → substitute into the **OTHER** equation → back-substitute → verify in both. A **true** leftover statement = infinitely many solutions; a **false** one = no solution.

The routine, and the trap inside each step

Worked on the pair $x + y = 7$ and $x - y = 3$. Three steps, then the check – many cards show the check as a fourth box.

Step	What you write	The trap
1 · Isolate	$x = 7 - y$	Isolating a variable with coefficient 3 → fractions
2 · Substitute, solve	$(7 - y) - y = 3 \Rightarrow y = 2$	Putting it into the same equation → $0 = 0$
3 · Back-substitute	$x = 7 - 2 = 5$	Stopping at y; half-multiplied brackets
Verify	$5 + 2 = 7 \checkmark$ $5 - 2 = 3 \checkmark$	Skipping it – the check line catches sign slips

Pick the variable with coefficient 1. If an equation is already written as $y = \dots$ or $x = \dots$, Step 1 is done for you – that is when substitution beats elimination.

What the leftover statement tells you

Step 2 ends in...	The lines	The pair
One value, e.g. $y = 2$	Meet at one point	Unique solution · consistent
A true statement, e.g. $18 = 18$	Same line	Infinitely many · dependent
A false statement, e.g. $-4 = 0$	Parallel	No solution · inconsistent

Self-check before you solve: compare a_1/a_2 , b_1/b_2 and c_1/c_2 . All three equal $\Rightarrow$ expect a true statement; only the first two equal $\Rightarrow$ expect a false one.

Where it sits: NCERT and CBSE

In NCERT	Chapter 3, taught in Section 3.3 (Algebraic Methods), practised in Exercise 3.2
Numbering trap	Section 3.3 but Exercise 3.2 – Ex 3.1 is graphical, Ex 3.3 elimination
Inside Ex 3.2	Q1 six pairs · Q2 solve, hence find m · Q3 six word problems
Removed	Cross-multiplication and equations reducible to linear form

CBSE wording: "Solution of a pair of linear equations in two variables algebraically – by substitution, by elimination. Simple situational problems." Algebra unit = **20 of 80** theory marks.

Key takeaways

- **Three steps:** isolate, substitute into the other equation and solve, back-substitute – then verify.
- Isolate the variable with **coefficient 1** to keep every line free of fractions.
- Always substitute into the equation you did **not** use in Step 1.
- Multiply **every term** in a bracket: $2(2x - 3) = 4x - 6$, not $4x - 3$.
- No variable left: **true** $\Rightarrow$ infinitely many solutions; **false** $\Rightarrow$ no solution.
- NCERT **Exercise 3.2** is only three questions – finish all of it before the board exam.

One word problem, start to finish

NCERT Exercise 3.2 · Q3(iv) · situational problem

Taxi charges are a fixed charge plus a charge per km. For 10 km the charge is Rs 105; for 15 km it is Rs 155. Find the fixed charge and the charge per km. How much is paid for 25 km?

Form Let the fixed charge be Rs x and the charge per km be Rs y . $x + 10y = 105 \dots (1)$ $x + 15y = 155 \dots (2)$

1 · Isolate From (1): $x = 105 - 10y$ (x has coefficient 1, so no fractions)

2 · Substitute Into (2): $(105 - 10y) + 15y = 155 \Rightarrow 105 + 5y = 155 \Rightarrow 5y = 50 \Rightarrow y = 10$

3 · Back-sub $x = 105 - 10(10) = 105 - 100 = 5$

Verify (1) $5 + 100 = 105$ ✓ (2) $5 + 150 = 155$ ✓

Use it For 25 km: $5 + 25 \times 10 = 5 + 250 = \text{Rs } 255$

Fixed charge **Rs 5**, charge per km **Rs 10**, and 25 km costs **Rs 255**.

Ex 3.2 · Q1(ii) · fractions in the pair

$s - t = 3$ and $s/3 + t/2 = 6$

Isolate: $s = t + 3$. Substitute: $(t + 3)/3 + t/2 = 6$.

Multiply **every term** by 6: $2(t + 3) + 3t = 36 \Rightarrow 5t + 6 = 36 \Rightarrow t = 6$, so $s = 9$.

Check: $9/3 + 6/2 = 3 + 3 = 6$ ✓

Ex 3.2 · Q1(iii) · the special case

$3x - y = 3$ and $9x - 3y = 9$

Isolate: $y = 3x - 3$. Substitute: $9x - 3(3x - 3) = 9$.

$9x - 9x + 9 = 9 \Rightarrow 9 = 9$ — true, no variable left.

So **infinitely many solutions**: the second equation is 3 × the first.

Substitution or elimination? Decide in five seconds

$y = 2x - 3$ · $3x + 2y = 8$

Substitution

y is already alone — Step 1 is done

$x + y = 14$ · $x - y = 4$

Substitution

x has coefficient 1: $x = 14 - y$ gives $x = 9$, $y = 5$

$2x + 3y = 13$ · $3x + 2y = 12$

Elimination

No coefficient is 1 — isolating any variable makes fractions

Where the marks actually go

Defining the variables

"Let the fixed charge be Rs x " — without it, the equations have no meaning

The isolate line

Write $x = 105 - 10y$ on its own line, even if it feels obvious

The substituted equation

Keep the brackets: $(105 - 10y) + 15y$, so a sign slip is visible

Answer and check

State both values with units, and show the verify line in both equations

Now try these — answers at the end

1. Ex 3.2 Q2: solve $2x + 3y = 11$ and $2x - 4y = -24$, and hence find m for which $y = mx + 3$.

2. Ex 3.2 Q3(vi): five years hence, Jacob's age will be three times his son's. Five years ago, it was seven times. Find their present ages.

Answers: 1. $x = -2$, $y = 5$, $m = -1$ · 2. Jacob 40 years, son 10 years

Make substitution automatic on examfront

- **Free Chapter 1** — start practising straight away, at no cost.
- **Mistake identification** — see whether you slip on the isolate line, a bracket or a sign.
- **Anytime tests** — take a topic test whenever you finish an exercise.
- **Weekly tests** — keep Pair of Linear Equations fresh alongside new chapters.
- **Mock tests before the exam** — full CBSE-pattern papers, 80 marks, 3 hours.

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