

CHAPTER 3

Pair of Linear Equations in Two Variables

CBSE · Mathematics · Class 10

WHAT THIS CHAPTER DOES

Boards prep that builds confidence, not anxiety.

TODAY'S MISSION

Today's Mission

WHY THIS MATTERS

The Big Picture

TOPIC

A

Setting Up the Pair

TOPIC

What a Pair of Linear Equations Looks Like

POINT 1

POINT 2

POINT 3

POINT 4

TOPIC

Three Geometric Cases — Three Algebraic Verdicts

TRY IT · SOLVE BEFORE YOU PEEK

Quick Test — Identify the Nature

Work it out before you flip the answer.

SOLUTION

TOPIC

B

Algebraic Method 1 — Substitution

THEOREM · LOAD-BEARING RESULT

Substitution Method — The Idea



From one equation, express one variable in terms of the other; substitute this expression into the second equation to convert it into a single-variable equation; solve; back-substitute to find the other variable.

STATEMENT

From one equation, express one variable in terms of the other; substitute this expression into the second equation to convert it into a single-variable equation; solve; back-substitute to find

WHY THIS MATTERS

- Two variables with two equations carry redundant information when one is derivable from the other
- Substitution removes a variable algebraically, just as a graph removes it geometrically by intersection.

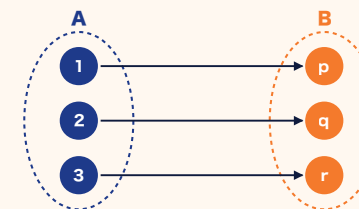
WATCH OUT FOR

NOTE PICK THE EQUATION with the simplest coefficient (look for a 1 or -1 in front of a variable). Choosing the harder side of the substitution doubles your arithmetic and your error rate.

WORKED EXAMPLE

Substitution Walk-Through — $7x - 15y = 2$, $x + 2y = 3$

- 1 Choose the simpler equation: $x + 2y = 3$ has a coefficient of 1 on x . Isolate x : $x = 3 - 2y$.
- 2 Substitute into $7x - 15y = 2$: $7(3 - 2y) - 15y = 2 \Rightarrow 21 - 14y - 15y = 2 \Rightarrow 21 - 29y = 2$.
- 3 Solve for y : $-29y = -19 \Rightarrow y = 19/29$.
- 4 Back-substitute: $x = 3 - 2(19/29) = (87 - 38)/29 = 49/29$.
- 5 Verify in eq1: $7(49/29) - 15(19/29) = (343 - 285)/29 = 58/29 = 2 \checkmark$. Solution: $(49/29, 19/29)$.



Substitution Funnel

TOPIC

Substitution — Pre-Flight Checklist

TOPIC

C

Algebraic Method 2 — Elimination

THEOREM · LOAD-BEARING RESULT

Elimination Method — The Idea



Scale one or both equations so that the coefficient of one variable becomes identical (or opposite). Add or subtract the equations to **ELIMINATE** that variable, leaving a one-variable equation. Solve. Then back-substitute.

STATEMENT

Scale one or both equations so that the coefficient of one variable becomes identical (or opposite). Add or subtract the equations to **ELIMINATE** that variable, leaving a one-variable equation. Solve. Then

WHY THIS MATTERS

- If two equations share a coefficient on y (say both have $+4y$), subtracting cancels y instantly
- Scaling lets us engineer that match for any pair.

WATCH OUT FOR

NOTE When you multiply, you must multiply **BOTH SIDES** of the equation by the same number — not just the side with the variable. And track signs carefully when subtracting.

WORKED EXAMPLE

Elimination Walk-Through — $3x + 4y = 10$, $2x - 2y = 2$

- 1 Goal: equal coefficient on y . Multiply eq2 by 2: $4x - 4y = 4$.
- 2 Stack with eq1: $3x + 4y = 10$ and $4x - 4y = 4$.
- 3 Add the equations (the $+4y$ and $-4y$ cancel): $7x = 14 \Rightarrow x = 2$.
- 4 Back-substitute into eq2: $2(2) - 2y = 2 \Rightarrow 4 - 2y = 2 \Rightarrow y = 1$.
- 5 Verify in eq1: $3(2) + 4(1) = 6 + 4 = 10 \checkmark$. Solution: $(2, 1)$.

TRY IT · SOLVE BEFORE YOU PEEK

Quick Test — Pick a Method

Work it out before you flip the answer.

SOLUTION

TOPIC

D

Graphical Method

TOPIC

Solving Graphically — Step by Step

POINT 1

POINT 2

POINT 3

POINT 4

WORKED EXAMPLE

Graphical Solve — $x + y = 7$ and $2x - y = 2$

- 1 Table for $x + y = 7$: (0, 7), (3, 4), (7, 0).
- 2 Table for $2x - y = 2$: (0, -2), (1, 0), (3, 4).
- 3 Plot both lines on the same graph paper.
- 4 They intersect at (3, 4). Read off: $x = 3$, $y = 4$.
- 5 Verify algebraically: $3 + 4 = 7$ ✓ and $2(3) - 4 = 2$ ✓.

TOPIC

E

Word Problems — Where the Marks Live

TOPPER TEMPLATE · MARK-BY-MARK

5-Mark Topper Answer — Father–Son Age Problem

1

2

3

4

5

WORKED EXAMPLE

Boat & Stream — 30 km Each Way

- 1 Let boat's still-water speed = b km/h, stream speed = s km/h.
- 2 Downstream: $b + s = 30/3 = 10$. Upstream: $b - s = 30/5 = 6$.
- 3 Add: $2b = 16 \Rightarrow b = 8$. Subtract: $2s = 4 \Rightarrow s = 2$.
- 4 Answer: Boat speed 8 km/h, stream speed 2 km/h.
- 5 Verify: downstream $(8 + 2) \times 3 = 30 \checkmark$; upstream $(8 - 2) \times 5 = 30 \checkmark$.

MARKS DISTRIBUTION

Where the Marks Live (last 6 years)

PYQ PATTERNS

5 Patterns That Repeat Every Year

TOPPER TEMPLATE · MARK-BY-MARK

Model answer template

- | | | |
|----------|------------------------------|---|
| 1 | STEP
0.5 m | From the second equation $x + 2y = 3$, isolate x : $x = 3 - 2y$. (Choose the easier one — substitution lives or dies on this choice.) |
| 2 | STEP
1 m | Replace x in $7x - 15y = 2$ by $(3 - 2y)$: $7(3 - 2y) - 15y = 2 \Rightarrow 21 - 14y - 15y = 2 \Rightarrow 21 - 29y = 2$. |
| 3 | STEP
0.75 m | $29y = 19 \Rightarrow y = 19/29$. |
| 4 | STEP
0.75 m | $x = 3 - 2(19/29) = 3 - 38/29 = (87 - 38)/29 = 49/29$. Check in eq1: $7(49/29) - 15(19/29) = (343 - 285)/29 = 58/29 = 2 \checkmark$. |

TOPPER TEMPLATE · MARK-BY-MARK

Model answer template

1 **STEP**

0.75 m

Multiply the second equation by 2 to match the y-magnitude with the first: $4x - 4y = 4$.

2 **STEP**

1 m

Add: $(3x + 4y) + (4x - 4y) = 10 + 4 \Rightarrow 7x = 14 \Rightarrow x = 2$.

3 **STEP**

0.75 m

Substitute $x = 2$ in $2x - 2y = 2$: $4 - 2y = 2 \Rightarrow y = 1$.

4 **STEP**

0.5 m

$3(2) + 4(1) = 6 + 4 = 10 \checkmark$. Solution: (2, 1).

TOPPER TEMPLATE · MARK-BY-MARK

Model answer template

1 STEP
0.5 m

Eq1: $kx + 2y - 5 = 0 \Rightarrow a_1=k, b_1=2, c_1=-5$. Eq2: $3x + y - 1 = 0 \Rightarrow a_2=3, b_2=1, c_2=-1$.

2 STEP
1 m

No solution $\Leftrightarrow a_1/a_2 = b_1/b_2 \neq c_1/c_2$. So $k/3 = 2/1 \Rightarrow k = 6$.

3 STEP
0.5 m

Check: $c_1/c_2 = -5/-1 = 5$. Since $2 \neq 5$, the ratios genuinely satisfy 'equal a,b ratios but unequal c-ratio'. So $k = 6$ gives no solution.

PYQ PATTERNS

Top PYQ patterns to drill

#1	Word problem (age / boat / fraction / digit / work)	set up + solve (4 marks) — 45%
#2	Solve a given pair by substitution or elimination (3 marks)	25%
#3	Find k for unique / no / infinite solutions (2 marks)	18%
#4	Graphical method	draw both lines and read the intersection (3 marks) — 8%
#5	Identify nature (unique/no/infinite) without solving (1 marks)	4%

RECAP · MEMORISE THESE

Chapter 3 in One Glance

1 Standard form first:
 $a_1x + b_1y + c_1 = 0$
(move everything to LHS, mind the c-sign).

2 Three cases by ratios:
unique ($a_1/a_2 \neq b_1/b_2$),
no ($a_1/a_2 = b_1/b_2 \neq c_1/c_2$), infinite (all three equal).

3 Substitution: isolate the variable with coefficient 1, plug in, solve, back-substitute.

4 Elimination: scale to equal coefficients, add/subtract to remove one variable, solve, back-substitute.

5 Word problems:
ALWAYS define x, y in the first line; translate each sentence to one equation; verify in plain English.

6 Cross-multiplication has been REMOVED from the 2025-26 syllabus — don't waste time on it.

WHAT'S NEXT

What's Next



Practice Activates Memory

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Boards prep that builds confidence, not anxiety.