MATHS WITHOUT GUESSWORK

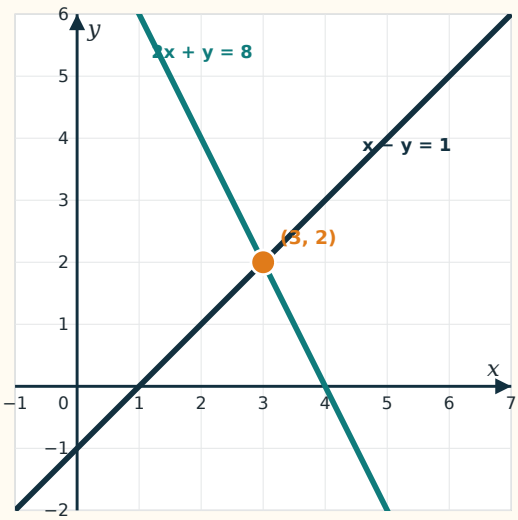
Pair of Linear Equations

in Two Variables

Understand the Relationship.
Choose the Method.
Solve Independently.

A step-by-step concept, problem-solving and board-exam practice workbook for Class 10 Mathematics

CBSE Class 10 Mathematics · Syllabus session 2026–27 · Volume 3



THREE CASES

Intersect
$a_1/a_2 \neq b_1/b_2$

Parallel
$a_1/a_2 = b_1/b_2 \neq c_1/c_2$

Coincident
$a_1/a_2 = b_1/b_2 = c_1/c_2$

$2x + y = 8$ and $x - y = 1$
meet at one point: the common solution $x = 3, y = 2$

Core topics: graphical method · substitution · elimination · number of solutions · word problems

Original explanations, examples and questions. Not a substitute for the NCERT textbook or your teacher.

Liked this? The full Pair of Linear Equations in Two Variables workbook is ₹99 →

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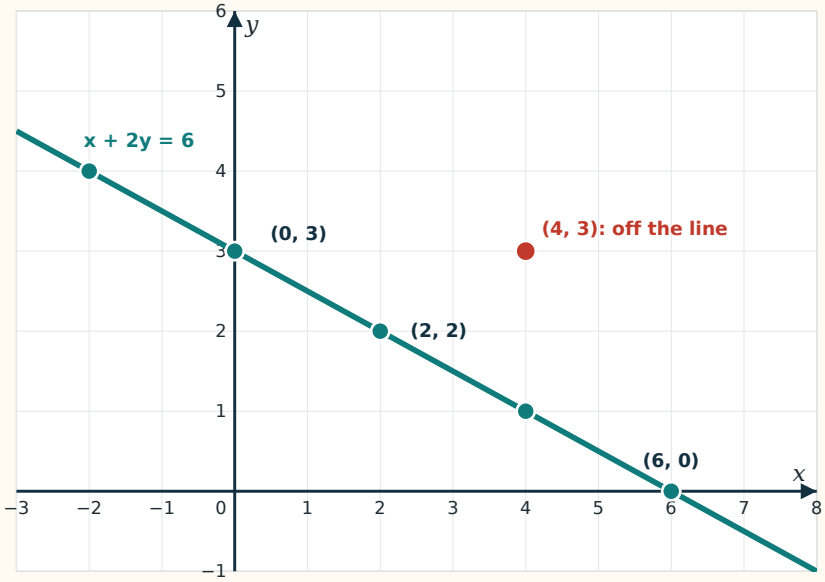
PREREQUISITE

An equation becomes a straight line

Learning objective: Plot solutions of an equation and see that they line up, and that other points do not lie on the line.

Take $x + 2y = 6$. Choose x, find y, and you get a table of solutions. Every solution is a point; plot them and look.

x	6	4	2	0	−2
$y = (6 - x)/2$	0	1	2	3	4



What the picture says

- Every plotted solution lies on one straight line.
- Every other point *on* the line is also a solution (for instance (3, 1.5): $3 + 2(1.5) = 6$).
- A point *off* the line is not a solution: (4, 3) gives $4 + 6 = 10$, not 6.

★ SPOT THE CLUE

Lines with a missing variable. $x = 3$ means x is always 3 and y can be anything, so it is a vertical line through (3, 0). $y = 2$ is a horizontal line through (0, 2). In ratio form they are $1x + 0y - 3 = 0$ and $0x + 1y - 2 = 0$, with a zero coefficient; page 18 returns to this.

➤ CHOOSE THE METHOD

Choosing points to plot. The easiest points make one variable zero: put $x = 0$ to find where the line meets the y-axis (here (0, 3)), and $y = 0$ for the x-axis (here (6, 0)). Plot a **third** point as a safety check: if the three do not lie on one line, one of them is wrong. A straight line needs only two points, but the third catches arithmetic slips.

✎ YOUR TURN

C4 (guided) For $2x - y = 4$: (a) find the points where it meets the axes, (b) find a third point, (c) say whether (3, 3) lies on the line and why.

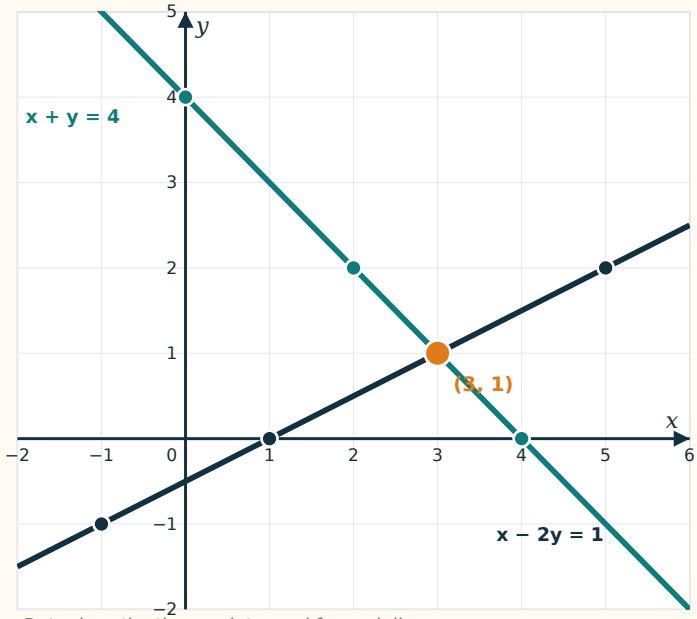
CORE

Graphical method: plot, read, check

Learning objective: Solve a pair by drawing both lines on one graph, reading the crossing point, and confirming it.

SPOT THE PROBLEM. Solve graphically: $x + y = 4$ and $x - 2y = 1$.

Demand: the point that lies on both lines, as an ordered pair (x, y). **Clue:** "graphically" means: draw.



Dots show the three points used for each line.

$x + y = 4$	x	0	4	2
	y	4	0	2
$x - 2y = 1$	x	1	5	−1
	y	0	2	−1

Reading: the lines cross at (3, 1).
Check (1): $3 + 1 = 4$ ✓
Check (2): $3 - 2(1) = 1$ ✓

Answer: x = 3, y = 1. The last column of each table is the third check point; all three points of a line must be in a straight row.

Step	Working	Why this step works
1 Tables	For each equation choose x, find y. Use x = 0 and y = 0 points, plus a third.	Intercepts are quick to compute; the third point catches slips.
2 Plot	Mark each point on one set of axes and join with a straight ruler line, extended both ways.	A line has no end; extending shows where it meets the other line.
3 Read	Find the one point lying on both lines: (3, 1).	A point on both lines satisfies both equations.
4 Check	Substitute into *both* original equations.	The graph can mislead; substitution cannot.

⚠ COMMON TRAP

Plotting an intercept wrongly. For $x - 2y = 1$ at x = 0: $-2y = 1$, so y = −1/2, not −1. Choose x-values that give whole-number y-values, like x = 1, 3, 5 here, so you can plot accurately.

✎ YOUR TURN

C8 (guided) Solve graphically: $x - y = 1$ and $x + y = 7$. Hint: points (1, 0), (0, −1) and (7, 0), (0, 7). Use axes from 0 to 8. State the solution and check it in both equations.

CORE

Elimination: make one unknown vanish

Learning objective: Add or subtract equations so that one variable disappears, and say why this keeps the solution.

? WHY THIS STEP?

Why adding equations is allowed. If two equations are true for a solution, then adding the two left sides gives the same number as adding the two right sides: equals added to equals stay equal. The new equation is also true for the solution. If the y-terms are $+2y$ and $-2y$, they add to 0, so y vanishes and we are left with an equation in x alone.

Example A: opposite coefficients, so add

Solve $3x + 2y = 10$ (1) and $5x - 2y = 22$ (2).

◆ VISUAL 5: ELIMINATION IN ACTION

ORIGINAL	MULTIPLY EVERY TERM	SCALED EQUATION
$3x + \boxed{2y} = 10$	**× 1** →	$3x + \boxed{2y} = 10$
$5x - \boxed{2y} = 22$	**× 1** →	$5x - \boxed{2y} = 22$
ADD (coefficients of y are opposite)		$8x = 32$
		the y-term has become 0

Step	Working	Why this step works
Add	$8x = 32$, so $x = 4$	y-terms $2y$ and $-2y$ cancel.
Back-sub	In (1): $3(4) + 2y = 10$, so $2y = -2$ and $y = -1$	Any original equation works; (1) is simpler.
Verify	(1) $3(4) + 2(-1) = 10$ ✓ (2) $5(4) - 2(-1) = 22$ ✓	Check both originals.

Example B: equal coefficients, so subtract

Solve $4x + 3y = 23$ (1) and $4x - y = 3$ (2).

The x-coefficients are both 4. **Subtract (2) from (1):** $(4x - 4x) + (3y - (-y)) = 23 - 3$, so $4y = 20$ and $y = 5$. Then $4x - 5 = 3$ gives $x = 2$. Verify: $4(2) + 3(5) = 23$ ✓; $4(2) - 5 = 3$ ✓.

⚠ COMMON TRAP

Subtracting a negative. In $3y - (-y)$ the minus-minus gives plus: $3y + y = 4y$. Writing $3y - y = 2y$ is the classic slip. Write the subtraction with brackets around the whole second equation.

✎ YOUR TURN

C12 (guided) Solve $3x + 2y = 7$ and $3x - 4y = -5$ by elimination. Hint: same x-coefficients, so subtract. Give the pair (x, y) and verify.

Doubts 1 and 2: pair, linear, and satisfying both

DOUBT 1 *"Why is it called a pair of LINEAR equations? What is linear about it?"*

✗ THINKING
"Linear" just means the equations are simple or short.

◆ EXPLANATION
An equation is **linear** if each variable has power 1 and no two variables are multiplied. Its graph is a straight line. A **pair** means two such equations taken together about the same x and y.

▦ SEE IT

Equation	Linear in x and y?	Why
$3x - 2y = 7$	yes	x, y to the power 1
$x^2 + y = 3$	no	x^2 is power 2
$xy = 8$	no	x × y: variables multiplied
$y = 5x$	yes	write as $5x - y = 0$

➤ REASONING
Look for powers and products: any x^2, y^2, or xy makes it non-linear.

★ MINI-EXAMPLE
$x + y = 5$ gives $y = 4, 3, 2$ for $x = 1, 2, 3$: points in a straight row. But $x^2 + y = 5$ gives $y = 4, 1, -4$: not a straight row, so not linear.

✎ YOUR TURN DB1
DB1 Which of these are linear in x and y? (a) $3x - 2y = 7$ (b) $xy = 8$ (c) $y = 5x$ (d) $x^2 - y = 1$. Give a reason for each.

✓ REMEMBER
Linear: power 1, no products, straight-line graph.

DOUBT 2 *"My pair (4, 3) works in the first equation, so it is a solution of the pair, right?"*

✗ THINKING
Satisfying one of the two equations is good enough.

◆ EXPLANATION
A solution of the pair must satisfy **both** equations, because the same x and the same y have to obey both conditions. A value that fits only one equation is a solution of that equation alone.

▦ SEE IT

Pair (x, y)	$x + y = 7$	$x - y = 3$	Solution of the pair?
(4, 3)	$4 + 3 = 7$ ✓	$4 - 3 = 1$ ✗	no
(6, 1)	$6 + 1 = 7$ ✓	$6 - 1 = 5$ ✗	no
(5, 2)	$5 + 2 = 7$ ✓	$5 - 2 = 3$ ✓	yes

➤ REASONING
Substitute into equation 1, then *separately* into equation 2. Both must say ✓.

★ MINI-EXAMPLE
For $x + y = 7$ and $x - y = 3$: (4, 3) gives $4 + 3 = 7$ ✓ but $4 - 3 = 1 \neq 3$. So (4, 3) is not a solution of the pair. (5, 2) passes both.

✎ YOUR TURN DB2
DB2 For $2x + y = 9$ and $x - y = 3$, test (3, 3) and (4, 1). Which, if either, is a solution of the pair?

✓ REMEMBER
One check is never enough: test both equations.

Decision tree: from the pair to the first step

Learning objective: Follow the branches from the structure of the pair to a sensible method, and know the check to run last.

VISUAL 7: Look at the pair (or the story)

Q1. Is it a story?
- yes → **Translate first**: define x, y; write two equations. Then continue at Q2 with the equations.
- no ↓

Q2. Does it say “graphically” or “draw”?
- yes → **Graph**: table, plot, read, then substitute to check.
- no ↓

Q3. Does it ask only how many solutions, or the type of lines?
- yes → **Ratios** a_1/a_2, b_1/b_2, c_1/c_2 (zero coefficient: reason directly).
- no ↓

Q4. Is a coefficient 1 or −1, or is a variable already alone?
- yes → **Substitution**: isolate, substitute in the other equation, back-substitute.
- no ↓

Q5. Are the coefficients of one variable equal or opposite?
- yes → **Elimination**: subtract if equal, add if opposite.
- no ↓

Otherwise → **Elimination with multipliers**: multiply every term so one variable matches, then add or subtract.

After any method, always: substitute the values into **both** original equations. If a step ends with only numbers: true (0 = 0) → infinitely many solutions; false (0 = 5) → no solution.

◆ UNDERSTAND

Why this order? Cheap decisions come first. A story must become equations before anything else. Graph and ratio questions are named by their wording. For plain algebra, substitution is cheapest when a variable is easy to isolate; elimination is cheapest when coefficients match; multipliers are the fallback. Different branches may reach the same answer, so use the tree as a guide, not a rule.

✎ YOUR TURN

C17 (guided) Walk each pair through the tree and write the branch you reach: (a) $y = 4x - 3$, $2x + y = 9$ (b) $5x + 2y = 11$, $5x - 3y = 1$ (c) $3x + 5y = 1$, $2x - 3y = 7$ (d) $x - 2y = 4$, $3x - 6y = 7$ (how many solutions?).

Mistake clinic (1 of 3)

MISTAKE 1 — Checking only one equation

✗ STUDENT'S WORK	Is (6, 3) a solution of $x + y = 9$ and $2x - y = 12$? "$6 + 3 = 9$ ✓, so yes."
⚠ WHERE IT FAILS	Only equation (1) was tested. In (2): $2(6) - 3 = 9 \neq 12$, so (6, 3) fails.
? WHY TEMPTING	After one ✓ the job feels finished.
✓ CORRECTED	(6, 3) is **not** a solution of the pair. The actual solution is (7, 2): $7 + 2 = 9$ ✓, $2(7) - 2 = 12$ ✓.
➤ PREVENTION RULE	A pair is a solution only if it makes **both** equations true.
✎ FIX IT E1	**E1** A student says (4, 5) is a solution of $x + y = 9$ and $x - y = 1$ because $4 + 5 = 9$. Correct it.

MISTAKE 2 — Wrong rearranging

✗ STUDENT'S WORK	Write y in terms of x from $3x + 2y = 12$. "$2y = 12 + 3x$, so $y = (12 + 3x)/2$."
⚠ WHERE IT FAILS	Moving 3x to the other side must change its sign: $2y = 12 - 3x$.
? WHY TEMPTING	Moving a term feels like just "sending it across".
✓ CORRECTED	$2y = 12 - 3x$, so $y = (12 - 3x)/2$. Test with (2, 3): $(12 - 6)/2 = 3$ ✓; the wrong version gives $(12 + 6)/2 = 9$ ✗.
➤ PREVENTION RULE	A term changes sign when it crosses "=". Test your rearranged result with a known solution.
✎ FIX IT E2	**E2** A student rearranges $5x - y = 7$ as $y = 5x + 7$. Find the error and correct it.

MISTAKE 3 — Multiplying only one term

✗ STUDENT'S WORK	Solve $x + 2y = 5$, $3x - y = 8$. "Multiply (1) by 3: $3x + 2y = 15$. Subtract (2): $3y = 7$."
⚠ WHERE IT FAILS	Multiplying (1) by 3 gives $3x + 6y = 15$: the 2y must also be multiplied.
? WHY TEMPTING	Only the x was "needed", so only the x gets changed.
✓ CORRECTED	$3x + 6y = 15$; subtract (2): $7y = 7$, $y = 1$, $x = 3$. Check $3 + 2 = 5$ ✓, $9 - 1 = 8$ ✓.
➤ PREVENTION RULE	Multiply every term, both sides.
✎ FIX IT E3	**E3** A student multiplies $2x - 3y = 4$ by 2 and writes $4x - 3y = 8$. Correct it and test with (5, 2).

Practice 1: foundation

Learning objective: Check the prerequisite ideas and the meaning of a solution of an equation and of a pair.

1 Guided | 2 Part-guided | 3 Independent | 4 Unfamiliar

Answers: Section H.

P1 Write each equation in the form $ax + by + c = 0$ and state a, b, c: (a) $2x + 5y = 9$ (b) $y = 3x - 4$ (c) $x/2 - y = 3$.

Purpose: Read coefficients with signs. **Foundation** ★☆☆

Working space (use separate paper if needed)

P2 Which of (1, 4), (2, 1), (−1, 7), (3, −2) are solutions of $3x + y = 7$?

Purpose: Substitute with brackets. **Foundation** ★☆☆

Working space (use separate paper if needed)

P3 Complete a table of solutions of $2x - y = 5$ for x = 0, 1, 3, −1.

Purpose: Find y from x. **Foundation** ★☆☆

Working space (use separate paper if needed)

P4 Is (3, −1) a solution of the pair $x + 2y = 1$ and $3x - y = 10$? Show your check.

Purpose: Test both equations. **Foundation** ★☆☆

Working space (use separate paper if needed)

P5 In your own words, explain why one linear equation in two variables has infinitely many solutions, but a pair usually has just one.

Purpose: Explain the idea of a common solution. **Standard** ★★☆

Working space (use separate paper if needed)

P6 True or false, with a reason: (a) A pair of linear equations always has a solution. (b) The graph of $x + y = 5$ is a straight line. (c) If (2, 3) satisfies one equation of a pair, it is a solution of the pair.

Purpose: Spot over-generalisations. **Standard** ★★☆

Working space (use separate paper if needed)

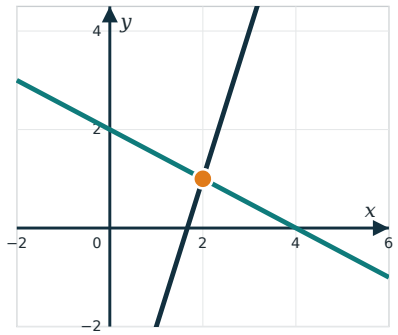
Revision map

Learning objective: Recall the key ideas, the three methods, the ratio conditions and the error checklist on one page.

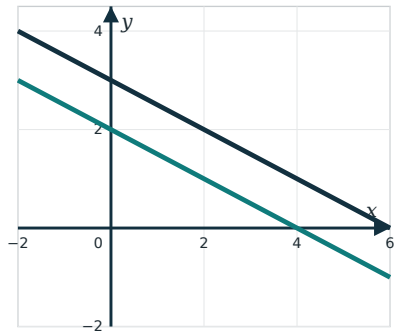
◆ UNDERSTAND

Pair of linear equations $a_1x + b_1y + c_1 = 0$, $a_2x + b_2y + c_2 = 0$. A solution is an ordered pair (x, y) that satisfies **both**. Each equation is a straight line; the crossing point is the common solution. **Methods:** graph (plot, read, check) · substitution (isolate, substitute in the other equation, back-substitute) · elimination (match a coefficient, add or subtract, back-substitute). **Always** verify in both original equations.

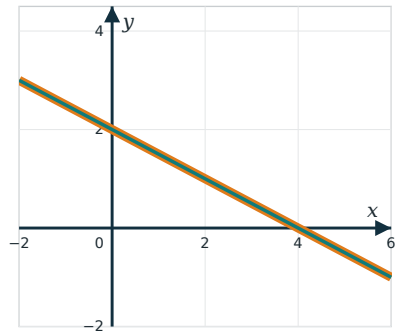
$a_1/a_2 \neq b_1/b_2$
intersecting lines
one solution · consistent



$a_1/a_2 = b_1/b_2 \neq c_1/c_2$
parallel lines
no solution · inconsistent



$a_1/a_2 = b_1/b_2 = c_1/c_2$
coincident lines
infinitely many · dependent (consistent)



Question clue	Method
It is a story	define x, y; two equations; solve; check in the story; answer in words
“Solve graphically”	3-point tables, ruler, read, then substitute to check
A coefficient is 1 or −1	substitution: isolate, bracket, expand, back-substitute
Equal or opposite coefficients	elimination: subtract if equal, add if opposite
Nothing matches	elimination with multipliers: multiply every term
Number of solutions	ratios; zero coefficient: reason directly
Variables vanish	true (0 = 0): infinitely many; false (0 = 5): none

⚠ COMMON TRAP

Final error checklist. ☐ check both equations (E1) ☐ sign when moving a term (E2) ☐ multiply every term (E3) ☐ subtract the whole equation, with brackets (E4) ☐ bracket the substituted expression (E5) ☐ find both variables (E6) ☐ compare all three ratios (E7) ☐ plot points that satisfy the equation (E8) ☐ test word equations with numbers; answer in words (E9)

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- **Foundation.** Concept explanations that build the ideas the chapter depends on.
- **Core methods.** Worked examples with a reason for every step, and quick checks to try.
- **Doubt Bank.** 16 common doubts answered clearly, each followed by a question to try.
- **Method recognition.** Clue tables, decision charts and look-alike questions that train you to choose the method.
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