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CHAPTER NOTES

Linear Equations in Two Variables Class 9 Notes | CBSE Maths

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Your teacher for Linear Equations in ...



Hi, I am **Ira**. I teach this syllabus all day, so **Linear Equations in Two Variables** is very much my home ground.

Ask me anything from this chapter. A concept, a numerical, or that one doubt you did not want to raise in class. Pick one to start:

Explain Linear Equations in Two Variables simply

What can the board exam ask?

Most important formulas

Quiz me on this chapter

Ask Ira anything...



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Linear Equations in Two Variables Class 9 Notes | CBSE Maths

Linear Equations in Two Variables is a chapter of CBSE Class 9 Maths (2026-27 syllabus), part of Unit II, Algebra. It starts from everyday situations, such as prices of two items or runs scored in fours and sixes, and writes them as equations of the form $ax + by + c = 0$. You then find solutions, draw the straight-line graph, read its slope and y-intercept, and solve a pair of such equations by graphs, substitution and elimination.

The chapter is assessed in school exams through writing equations in standard form, checking and finding solutions, drawing graphs, rewriting in slope-intercept form, deciding whether a pair has one, none or infinitely many solutions, and solving word problems. It is the direct foundation for the Class 10 chapter Pair of Linear Equations in Two Variables, so the methods you learn here carry straight into the board year.

Quick Answer - Linear Equations in Two Variables

A **linear equation in two variables** can be written in the form $ax + by + c = 0$, where a , b are not both zero. Its graph is a straight line. With $b \neq 0$ it can be written as $y = -\frac{a}{b}x - \frac{c}{b}$, where $-\frac{c}{b}$ is the y-intercept (a new c , equal to $-c/b$).
pair: intersecting lines give one solution, parallel lines give no solution, and coincident lines give infinitely many. Solve a pair by graphs, substitution and elimination.



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All Key Formulas at a Glance

Idea	Rule or Formula	Remember
Standard form	$ax + by + c = 0$, a and b not both zero	Move every term to the left side
Solution	Ordered pair (x, y) that makes $LHS = RHS$	Substitute both values
Crossing the x-axis	Put $y = 0$	Point $(-c/a, 0)$ when $a \neq 0$
Crossing the y-axis	Put $x = 0$	Point $(0, -c/b)$ when $b \neq 0$
Slope-intercept form	$y = mx + c$	Here c is the y-intercept, a different c from $ax + by + c = 0$
Slope and intercept from standard form	$m = -a/b$, y -intercept c/b	
Slope through two points	$m = (y_2 - y_1) / (x_2 - x_1)$	
Lines parallel to the axes	$x = k$ (parallel to y-axis) $y = k$ (parallel to x-axis)	
Exactly one solution	$a_1/a_2 \neq b_1/b_2$	
No solution	$a_1/a_2 = b_1/b_2$ but $c_1/c_2 \neq 1$	
Infinitely many solutions	$a_1/a_2 = b_1/b_2$ and $c_1/c_2 = 1$	



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Key Concepts

1. Linear Equations in Two Variables

Many everyday situations link two unknowns using only fours and sixes. You do not know

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know the total. If the number of fours is x and the number of sixes is y , the runs from fours are $4x$ and the runs from sixes are $6y$, so

$4x + 6y = 40$

This is one equation with two unknowns. Each unknown appears only to the power 1, and the two unknowns are never multiplied together. Such an equation is called a **linear equation in two variables**.

More examples from daily life:

- A pen costs Rs x and a notebook costs Rs y . Two pens and three notebooks cost Rs 110: $2x + 3y = 110$.
- An auto charges Rs 25 for the first kilometre and Rs 15 for every kilometre after that. For a trip of x km the fare is $y = 25 + 15(x - 1) = 15x + 10$.

The standard form

Every linear equation in two variables can be written in the standard form

$ax + by + c = 0$

where a , b and c are real numbers and a and b are not both zero. If a term is on the right side, changing the sign of that term and moving it to the left side, changing the sign of the number in front of x , the number in front of y , and the number in front of the constant term.

Given equation	Standard form
$3x = 2y + 7$	$3x - 2y - 7 = 0$
$y = 4$	$0 \cdot x + 1 \cdot y - 4 = 0$
$x = -3$	$1 \cdot x + 0 \cdot y + 3 = 0$
$x/2 + y/3 = 1$	$3x + 2y - 6 = 0$

$y = 4$ is still a linear equation in two variables, even though b is not zero **at the same time**. The same relationship as $3x + 2y - 6 = 0$.



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How to spot an equation that is not linear

Look at the variables, never at the numbers in front of them.

- $x^2 + y = 3$ has x squared, so it is not linear.
- $xy = 4$ multiplies the two variables, which makes a term of degree 2.
- $2/x + y = 1$ has x in the denominator, which is x to the power -1 .
- $\sqrt{x} + y = 2$ has x to the power $1/2$.
- $\sqrt{2} x + y = \sqrt{3}$ **is** linear, because $\sqrt{2}$ is only a coefficient. $x/4 - y/5 = 1$ is linear too, because $x/4$ is $(1/4)x$.

One variable or two

As an equation in one variable, $2x + 3 = 0$ has one solution, $x = -3/2$, a single point on the number line. As an equation in two variables it is $2x + 0 \cdot y + 3 = 0$, and every pair $(-3/2, y)$ is a solution: a whole line in the plane. Read wh

2. Solutions of a Linear Equation i

A **solution** of a linear equation in two varia makes the two sides of the equation equal first.

Checking a pair

Substitute both values and compare the tv

- For $x + 3y = 7$, the pair $(1, 2)$ gives $1 + 6$
- The pair $(2, 1)$ gives $2 + 3 = 5$, and $5 \neq 7$ matters.

Why there are infinitely many solut

Take $2x + y = 7$. Choose any value of x , an $y = 7 - 2x$.

x	0
$y = 7 - 2x$	7



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Since x can be any real number, the list never ends. One linear equation in two variables has **infinitely many solutions**; pinning down a single pair needs a second equation.

Finding a missing value

If a point with one unknown coordinate lies on the line, substitute the known coordinate and solve. Suppose $(k, 2)$ is a solution of $3x - 2y = 11$. Then $3k - 4 = 11$, so $3k = 15$ and $k = 5$.

3. Graph of a Linear Equation in Two Variables

Each solution (x, y) is a point on the Cartesian plane. When you plot several solutions of the same linear equation, they all fall on **one straight line**. This is why the equation is called linear.

Take $x + 2y = 6$, so $y = (6 - x)/2$.

x	0	2
y	3	2

Choosing even values of x keeps every y a whole number. $(6, 0)$ lie on one line.

Every point on the line is a solution, and even if you don't know the equation, you can substitute it; no drawing is needed. $(4, 1)$ lie on the line because $1 + 8 = 9$.

Where the line crosses the axes

Every point on the x -axis has $y = 0$, and every point on the y -axis has $x = 0$.

- **x-intercept point:** put $y = 0$. For $x + 2y = 6$, $x = 6$.
- **y-intercept point:** put $x = 0$. For $x + 2y = 6$, $y = 3$.

These two points are the fastest way to draw the line. The area of the triangle formed by the line $x + 2y = 6$ and the axes is $(1/2) \times 6 \times 3 = 9$ square units.

Special lines: $x = k$ is parallel to the y -axis and $y = 0$ is the x -axis. A line such as $ax + by = 0$, with no constant, is called a line through the origin.



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4. Slope-Intercept Form $y = mx + c$

When $b \neq 0$, any linear equation $ax + by + c = 0$ can be rearranged to make y the subject:

$$by = -ax - c, \text{ so } y = (-a/b)x + (-c/b)$$

This is the **slope-intercept form**, usually written $y = mx + c$. The CBSE course structure writes the same form as $y = ax + b$; only the letters differ. In these notes, m is the slope and c (in $y = mx + c$) is the y -intercept. Do not confuse this c with the constant c of the standard form. From the rearrangement above, $m = -a/b$ and the y -intercept is $-c/b$.

What m and c mean

- **Slope m** tells you how much y changes when x increases by 1. If $m = 2$, y goes up by 2 for every step of 1 in x .
- **y -intercept c** is the value of y when $x = 0$.

A positive slope means the line rises from left to right. A negative slope means the line falls from left to right. A slope of 0 gives a horizontal line. A vertical line $x = k$ has an undefined slope. A slope of m (ignoring sign) means a steeper line:

Converting to slope-intercept form

Take $3x + 2y = 8$. Move $3x$ across: $2y = -3x + 8$. Divide by 2: $y = -\frac{3}{2}x + 4$. The slope is $-3/2$ and the y -intercept is 4.

Slope from two points

If a line passes through (x_1, y_1) and (x_2, y_2) , the slope is

$$m = (y_2 - y_1)/(x_2 - x_1), \text{ that is, change in } y \text{ over change in } x$$

Through $(0, -1)$ and $(2, 5)$: $m = (5 - (-1))/(2 - 0) = 3$. The line is $y = 3x - 1$. Check with $(2, 5)$: $5 = 3(2) - 1$.

Parallel lines

Two lines with the **same slope and different y -intercepts** are parallel. They have the same slope and different y -intercepts, so they never intersect. Two lines with the same slope and the same y -intercept are the same line.



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5. Drawing Graphs When x and y Take Only Certain Values

In many real situations the variables can only be whole numbers. You cannot buy 2.5 pens or hit 1.3 sixes. The equation still describes a straight line, but only some points on that line make sense.

Return to the batter: $4x + 6y = 40$, with x fours and y sixes. Dividing by 2 gives $2x + 3y = 20$, so $x = (20 - 3y)/2$. For x to be a whole number, $20 - 3y$ must be even, so y must be even.

y (sixes)	0	2	4	6
x (fours)	10	7	4	1

Check one: $4(7) + 6(2) = 28 + 12 = 40$. At $y = 8$, x would be -2, which is impossible. So the batter could have scored the 40 runs in exactly four ways, and the graph is **four separate points**: (10, 0), (7, 2), (4, 4) and (1, 6). They lie on the line $2x + 3y = 20$ but you do **not** join them, because points between them (like $x = 5.5$) have no meaning.

When a question says “x and y are whole numbers”, you must draw dots only. When x and y can be any real numbers, you draw a continuous line.

6. Pair of Linear Equations: Graphical Method

Two linear equations in the same two variables are called a **pair of linear equations in two variables**. In general form they are

$a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$

A **solution of the pair** is an ordered pair (x, y) which satisfies both equations. On a graph, it is a point that lies on both lines.

The graphical method

Draw both lines on the same axes and read off the solution. There are three possibilities:



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$$x + y = 5$$

x	0	5	3
y	5	0	2

$$x - y = 1$$

x	0	1	3
y	-1	0	2

Both lines pass through (3, 2), so the solution is $x = 3, y = 2$. Check: $3 + 2 = 5$ and $3 - 2 = 1$.

The graphical method has a limit: a meeting point such as (1.37, 2.81) cannot be read exactly from graph paper. The algebraic methods

Three possibilities for two lines

Lines	Number of solutions
Intersecting	Exactly one
Parallel	None
Coincident (one on top of the other)	Infinitely many

A pair is **consistent** if it has at least one solution.

Testing without drawing: the ratio method

Compare the ratios of the coefficients of the two equations. If $a_1/a_2 = b_1/b_2 = c_1/c_2$, then the lines are coincident. If $a_1/a_2 = b_1/b_2 \neq c_1/c_2$, then the lines are parallel. If $a_1/a_2 \neq b_1/b_2$, then the lines intersect at exactly one point.

- $a_1/a_2 \neq b_1/b_2$: intersecting lines, exactly one solution
- $a_1/a_2 = b_1/b_2 \neq c_1/c_2$: parallel lines, no solution
- $a_1/a_2 = b_1/b_2 = c_1/c_2$: coincident lines, infinitely many solutions



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- $a_1/a_2 = b_1/b_2 = c_1/c_2$: coincident lines, infinitely many solutions.

7. Algebraic Methods: Substitution and Elimination

Substitution method

1. From one equation, write one variable in terms of the other. Pick the equation where a variable has coefficient 1 or -1 if you can.
2. Substitute that expression into the **other** equation. You now have an equation in one variable.
3. Solve it, then put the value back into the expression from step 1. Check both values in both equations.

Solve $2x + 3y = 11$ and $x - 2y = -12$. From the second, $x = 2y - 12$. Substitute into the first: $2(2y - 12) + 3y = 11$, so $4y - 24 + 3y = 11$, $7y = 35$ and $y = 5$. Then $x = 2(5) - 12 = -2$. Check: $2(-2) + 3(5) = -4 + 15 = 11$, and $-2 - 2(5) = -12$. Both hold.

Elimination method

1. Multiply one or both equations by suitable numbers to get the same coefficient (or coefficients that differ by a multiple) for one variable.
2. Subtract the equations if the coefficients are the same, or add them if they are negatives. One variable disappears.
3. Solve, substitute back into either original equation, and check.

Solve $3x + 4y = 10$ and $2x - 2y = 2$. Multiply the second by 2 so coefficients are +4 and -4, so add: $7x = 14$. $x = 2$. Check in the second equation: $2(2) - 2(1) = 2$.

What the algebra tells you about the solution

Sometimes both variables disappear together. This can happen in three ways:

- $x + 2y = 4$ and $2x + 4y = 12$. Double the first: $2x + 4y = 8$, a **false** statement. The pair has **no solution**.
- $x + 2y = 4$ and $3x + 6y = 12$. Triple the first: $3x + 6y = 12$, that is **always true**. The pair has **infinitely many solutions**.

So all three methods, graphs, the ratio test, and the discriminant tell you the same thing about a pair of linear equations.



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8. Modelling Real Situations With a Pair of Equations

Use the same four steps for every contextual problem.

1. **Name the unknowns.** Write exactly what x and y stand for, with units. "Let the cost of one pen be Rs x ."
2. **Translate each condition into one equation.** Two independent conditions give two equations.
3. **Solve** by substitution, elimination or graphs.
4. **Check and conclude.** Test the answer in the original words, not only in your equations, and answer the exact question asked.

Common problem types

Type	How to set it up
Tickets or coins	One equation connects the number of items and the money (price $\times$ number)
Ages	Shift both ages to the same year (e.g. $y - 5$)
Two-digit numbers	Tens digit x , units digit y
Comparing two plans	Write $y = mx + c$ for each plan and find the break-even point

If your answer gives a negative number of items, or a digit above 9, the model or the arithmetic is wrong.



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Formula and Theorem Sheet

Topic	Formula or Rule	When to use it
Standard form	$ax + by + c = 0$, a and b not both zero	Identifying a , b , c ; ratio test
x-axis crossing	Put $y = 0$: point $(-c/a, 0)$, $a \neq 0$	Fast graphing, area with the axes
y-axis crossing	Put $x = 0$: point $(0, -c/b)$, $b \neq 0$	Fast graphing, area with the axes
Slope-intercept form	$y = mx + c$ (written $y = ax + b$ in the syllabus)	Reading slope and intercept; this c is the y-intercept, a different c from the standard form
Slope from standard form	$m = -a/b$, y-intercept $= -c/b$	
Slope from two points	$m = (y_2 - y_1)/(x_2 - x_1)$	
Parallel lines	Same m , different c	
Unique solution	$a_1/a_2 \neq b_1/b_2$	
No solution	$a_1/a_2 = b_1/b_2 \neq c_1/c_2$	
Infinitely many solutions	$a_1/a_2 = b_1/b_2 = c_1/c_2$	
Area of triangle cut off by a line and the axes	$(1/2) \times \text{x-intercept} \times \text{y-intercept} $	



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Important Definitions

- **Linear equation in two variables:** an equation that can be written in the form $ax + by + c = 0$, where a, b, c are real numbers and a and b are not both zero.
- **Solution of a linear equation in two variables:** an ordered pair (x, y) of values that makes the two sides of the equation equal.
- **x-intercept:** the x-coordinate of the point where a line crosses the x-axis (found by putting $y = 0$).
- **y-intercept:** the y-coordinate of the point where a line crosses the y-axis (found by putting $x = 0$). In $y = mx + c$ it is c .
- **Slope:** the change in y for an increase of 1 in x ; for two points on the line, $(y_2 - y_1)/(x_2 - x_1)$. In $y = mx + c$ it is m .
- **Pair of linear equations in two variables:** two linear equations in the same two variables x and y , considered together.
- **Solution of a pair:** an ordered pair (x, y)
- **Consistent pair:** a pair that has at least one solution
- **Inconsistent pair:** a pair that has no solution



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Solved Examples

Example 1: Finding an unknown coefficient

(a) If $x = 2, y = 1$ is a solution of $2x + 3y = k$, find the value of k .

Solution: (a) Substitute: $2(2) + 3(1) = k$, so $k = 7$.

(b) Substitute $x = k$ and $y = 2$: $3k - 2(2) = 7$, so $k = 5$.

Example 2: Graph, intercepts and area

Draw the graph of $2x + y = 6$. Find where it crosses the axes and find the area of the triangle it forms with the axes.

Solution: Write $y = 6 - 2x$.

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x	0	1	2	3
y	6	4	2	0

Plot (0, 6), (1, 4), (2, 2) and (3, 0) and join them with a straight line.

y-axis: $x = 0$ gives $y = 6$, so the point is (0, 6). x-axis: $y = 0$ gives $2x = 6$, $x = 3$, so the point is (3, 0).

(1, 4): $2(1) + 4 = 6$, so yes, it lies on the line (it is in the table).

The triangle has vertices (0, 0), (3, 0) and (0, 6). Area = $(1/2) \times 3 \times 6 = \mathbf{9 \text{ square units}}$.

Example 3: Converting to slope-intercept form

Write $5x - 2y = 10$ in the form $y = mx + c$. State its slope, its y-intercept and the x-intercept; it meets the x-axis.

Solution: $5x - 2y = 10$ gives $-2y = -5x + 10$

Slope $m = 5/2$; y-intercept $c = -5$, so the line is $y = (5/2)x - 5$

x-axis: put $y = 0$: $0 = (5/2)x - 5$, so $x = 2$. The line meets the x-axis at (2, 0).

Example 4: Graph when x and y take only whole number values

Pencils cost Rs 3 each and erasers Rs 5 each. Find all possible purchases, and describe the region in which the solutions lie.

Solution: Let x be the number of pencils and y be the number of erasers. x and y whole numbers.

Since $3x = 30 - 5y$, the value $30 - 5y$ must be a multiple of 3.

y	0	1
$30 - 5y$	30	25
x	10	no



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The possible purchases are (10, 0), (5, 3) and (0, 6). For y above 6 the value of x would be negative. The graph is **three separate points** on the line $3x + 5y = 30$, and they are not joined.

Example 5: Solving a pair graphically

Solve graphically: $x + 2y = 8$ and $2x - y = 1$.

Solution:

$x + 2y = 8$, so $y = (8 - x)/2$				
x	0	2	4	8
y	4	3	2	0

$2x - y = 1$	
x	0
y	-1

Both tables contain (2, 3), so the lines intersect at (2, 3).
 $x + 2y = 8$ and $4 - 3 = 1$.

Example 6: Nature of solutions and

(a) Without solving, state the nature of each pair of lines. (i) $x - 2y = 1$. (b) Find k for which $kx + 3y = 5$ and $2x - y = 1$ have no solution.

Solution: (a)(i) $a_1/a_2 = 3/1 = 3$ and $b_1/b_2 = 1/2 = 0.5$. Since $3 \neq 0.5$, the lines intersect at a single point.
(b) For no solution we need $a_1/a_2 = b_1/b_2 \neq c_1/c_2$. Here $a_1/a_2 = k/2$ and $b_1/b_2 = 3/(-1) = -3$. So $k/2 = -3$, which gives $k = -6$.

(ii) In standard form: $2x - 4y - 5 = 0$ and $x - 2y - 1 = 0$. Here $a_1/a_2 = 2/1 = 2$ and $b_1/b_2 = (-4)/(-2) = 2$. Since $2 = 2$, the lines are either coincident or parallel. Since $c_1/c_2 = (-5)/(-1) = 5$ and $2 \neq 5$, the lines are parallel and have no solution.

(b) For no solution we need $a_1/a_2 = b_1/b_2 \neq c_1/c_2$. Here $a_1/a_2 = k/2$ and $b_1/b_2 = 3/(-1) = -3$. So $k/2 = -3$, which gives $k = -6$.



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Example 7: Substitution method

Solve $3x - y = 7$ and $2x + 5y = 16$ by substitution.

Solution: From the first equation, $y = 3x - 7$. Substitute into the second:

$$2x + 5(3x - 7) = 16, \text{ so } 2x + 15x - 35 = 16, 17x = 51, \text{ and } x = 3.$$

Then $y = 3(3) - 7 = 2$. So **$x = 3, y = 2$** .

Check: $3(3) - 2 = 7$ and $2(3) + 5(2) = 6 + 10 = 16$.

Example 8: Elimination method

Solve $5x + 3y = 35$ and $2x - 4y = -12$ by elimination.

Solution: To eliminate y , make its coefficients 12 and -12. Multiply the first equation by 4 and the second by 3:

$$20x + 12y = 140 \text{ and } 6x - 12y = -36.$$

Add: $26x = 104$, so $x = 4$. Substitute into the first equation:

So **$x = 4, y = 5$** . Check in the second equation: $2(4) - 4(5) = 8 - 20 = -12$.

Example 9: Cost of pens and notebooks

3 pens and 2 notebooks cost Rs 110. 2 pens and 5 notebooks cost Rs 220. Find the cost of one pen and one notebook.

Solution: Let one pen cost Rs p and one notebook cost Rs n .

$$3p + 2n = 110 \dots (1) \text{ and } 2p + 5n = 220 \dots (2)$$

Multiply (1) by 2 and (2) by 3: $6p + 4n = 220$ and $6p + 15n = 660$. Subtract the first from the second: $11n = 440$, so $n = 40$.

From (1): $3p + 80 = 110$, so $3p = 30$ and $p = 10$.

A pen costs **Rs 10** and a notebook costs **Rs 40**.



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Example 10: Ages of a father and son

The sum of the ages of a father and his son is 50 years. Five years ago, the father was seven times as old as the son. Find their present ages.

Solution: Let the father's present age be f years and the son's be s years.

$$f + s = 50 \dots (1)$$

Five years ago their ages were $(f - 5)$ and $(s - 5)$, so $f - 5 = 7(s - 5)$, which gives $f - 5 = 7s - 35$, that is $f - 7s = -30 \dots (2)$

Subtract (2) from (1): $8s = 80$, so $s = 10$. Then $f = 50 - 10 = 40$.

The father is **40 years** old and the son is **10 years** old. Check: five years ago they were 35 and 5, and $35 = 7 \times 5$.

Example 11: A two-digit number

The sum of the digits of a two-digit number is 9. When the digits are reversed, the number is more than the original number. Find the number.

Solution: Let the tens digit be x and the units digit be y . Then the original number is $10x + y$ and the reversed number is $10y + x$.

$$x + y = 9 \dots (1)$$

$$(10y + x) - (10x + y) = 27, \text{ so } 9y - 9x = 27, \text{ that is } y - x = 3 \dots (2)$$

Add (1) and (2): $2y = 12$, so $y = 6$, and $x = 3$. The number is 36.

Competency-Based Questions

1. Case-based: Choosing a data plan

A mobile company offers two monthly plans. Plan A has a fixed charge of ₹100 and ₹10 per GB used. Plan B has a fixed charge of ₹150 and ₹8 per GB used. If x is the number of GB used in a month and y is the monthly bill in rupees, then



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(a) Write the equation for each plan. Plan A: $y = 10x + 150$. Plan B: $y = 20x + 50$.

(b) For what usage do the two plans cost the same, and what is that cost? $10x + 150 = 20x + 50$ gives $100 = 10x$, so $x = 10$ GB. The cost is $10(10) + 150 = \text{Rs } 250$.

(c) Which plan should a user who needs 15 GB choose? Plan A: $10(15) + 150 = \text{Rs } 300$. Plan B: $20(15) + 50 = \text{Rs } 350$. Plan A is cheaper by Rs 50.

2. Case-based: School annual day tickets

For the school annual day, adult tickets cost Rs 100 and child tickets cost Rs 60. On the first evening, 50 tickets were sold for a total of Rs 4200.

(a) Form a pair of linear equations. Let a be the number of adult tickets and c the number of child tickets. $a + c = 50$ and $100a + 60c = 4200$.

(b) Solve the pair. From the first, $c = 50 - a$.
 $3000 - 60a = 4200$, $40a = 1200$ and $a = 30$.

(c) Interpret the answer. 30 adult tickets and 20 child tickets.
 $60 = 3000 + 1200 = 4200$.

3. Case-based: Filling and draining

Tank P holds 600 litres and is being drained at 25 litres per minute. Tank Q, which holds 100 litres, is being filled at 25 litres per minute. Find the volume of water in litres.

(a) Write an equation for each tank. Tank P: $y = -25x + 600$ (linear growth).

(b) When will the tanks hold equal amount of water? $-25x + 600 = 25x + 100$, so $x = 10$ minutes. Each tank then holds 350 litres.

(c) When will tank P be empty? $600 - 25x = 0$, so $x = 24$. The point on the x-axis at $(24, 0)$.

4. Assertion-Reason

Assertion (A): The graph of $y = 3$ is a line. **Reason (R):** The equation $0 \cdot x + 1 \cdot y - 3 = 0$, so it is a linear equation.



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Options: (a) Both A and R are true and R is the correct explanation of A. (b) Both A and R are true but R is not the correct explanation of A. (c) A is true but R is false. (d) A is false but R is true.

Answer: (b). Both statements are true. R only shows that $y = 3$ is linear. The line is parallel to the x-axis because every point on it has y-coordinate 3.

5. Assertion-Reason

Assertion (A): The pair $2x + 3y = 5$ and $4x + 6y = 10$ has infinitely many solutions. **Reason (R):** For this pair, $a_1/a_2 = b_1/b_2 = c_1/c_2$.

Answer: (a). The ratios are $2/4$, $3/6$ and $(-5)/(-10)$, all equal to $1/2$. The second equation is twice the first, so the lines coincide and every point on one is on the other. R is the correct explanation of A.

6. Assertion-Reason

Assertion (A): The linear equation $2x + 5y = 10$ is a linear equation in two variables is a straight line.

Answer: (d). A is false: $(5, 0)$, $(0, 2)$ and $(2, 0)$ are points on the line. R is true: every point on the straight line is a solution.

7. Data reasoning: A savings table

Aman records the money in his savings bank account as follows:

Day (x)	Money in Rs (y)
1	5
2	10
3	15
4	20
5	25
6	30
7	35
8	40
9	45
10	50

(a) Is the relationship linear? Give a reason. Yes, because the amount saved is the same amount, 3.

(b) Write the equation in the form $y = mx + c$. $y = 3x + 5$.

(c) How much will he have at the end of 10 days? $10: 3(10) + 5 = \text{Rs } 35$. For Rs 50: $3x + 5 = 50$



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8. Error analysis

A student solved $x + y = 7$ and $x - y = 3$ as follows: "Subtracting, $2y = 10$, so $y = 5$ and $x = 2$."
Find the error and give the correct solution.

Answer: Subtracting the second equation from the first gives $(x + y) - (x - y) = 7 - 3$, that is $2y = 4$. The student added the right-hand sides while subtracting the left-hand sides. Correct working: $y = 2$ and $x = 5$. Check: $5 + 2 = 7$ and $5 - 2 = 3$.

Important Questions for Exams

1-Mark Questions

Q1. Write $2x = y$ in the form $ax + by + c = 0$ and state a, b, c .

$2x - y + 0 = 0$, so $a = 2, b = -1, c = 0$.

Q2. Is $(2, -1)$ a solution of $3x + 2y = 4$?

$3(2) + 2(-1) = 6 - 2 = 4$. Yes, it is a solution.

Q3. Write the slope and y-intercept of $y = -4x + 7$.
Slope -4 , y-intercept 7 .

Q4. How many solutions does the equation $2x + 3y = 6$ have?
Infinitely many.

Q5. Write the equation of the x-axis.
 $y = 0$.

2-Mark Questions

Q6. Find k if $(3, k)$ lies on the line $4x - y = 12$.
 $4(3) - k = 12$, so $12 - k = 12$ and $k = 0$.

Q7. Find the points where $3x + 4y = 12$ meets the x-axis and y-axis.
Put $y = 0$: $3x = 12$, $x = 4$, giving $(4, 0)$. Put $x = 0$: $4y = 12$, $y = 3$, giving $(0, 3)$.

Q8. Without solving, state whether $3x - y = 2$ and $9x - 3y = -6$ have any solutions.

In standard form, $3x - y - 2 = 0$ and $9x - 3y - 6 = 0$.
Slope of first line = $(-3)/(-6) = 1/2$. Slope of second line = $(-9)/(-6) = 3/2$.
Slopes are not equal, so no solutions (parallel lines).



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Q9. Write $6x + 3y = 9$ in the form $y = mx + c$ and state the slope.

$3y = -6x + 9$, so $y = -2x + 3$. Slope -2 , y -intercept 3 .

3-Mark Questions

Q10. Solve by substitution: $x + y = 10$ and $2x - y = 11$.

From the first, $y = 10 - x$. Substitute: $2x - (10 - x) = 11$, so $3x - 10 = 11$, $3x = 21$, $x = 7$. Then $y = 10 - 7 = 3$. Check: $7 + 3 = 10$, and $14 - 3 = 11$. Answer: $x = 7$, $y = 3$.

Q11. Solve by elimination: $4x + 3y = 18$ and $3x - 2y = 5$.

Multiply the first by 2 and the second by 3: $8x + 6y = 36$ and $9x - 6y = 15$. Add: $17x = 51$, $x = 3$. Then $4(3) + 3y = 18$, $3y = 6$, $y = 2$. Check: $3(3) - 2(2) = 9 - 4 = 5$. Answer: $x = 3$, $y = 2$.

Q12. For what value of k does the pair $2x + ky = 7$ and $4x + 6y = 3$ have no solution?

No solution needs $a_1/a_2 = b_1/b_2 \neq c_1/c_2$. So $2/4 = k/6$, giving $k = 3$. Check: $c_1/c_2 = (-7)/(-3) = 7/3$, which is not equal to $1/2$. So $k = 3$.

5-Mark Questions

Q13. Solve graphically: $x - y = 1$ and $2x +$

Table for $x - y = 1$ ($y = x - 1$): $(0, -1)$, $(1, 0)$, $(2, 1)$. Plot both lines on the same axes. They intersect at $(3, 2)$. Check: $6 + 2 = 8$.

Q14. A fraction becomes $1/3$ when 2 is subtracted from the numerator and 6 is subtracted from the denominator.

Let the fraction be x/y . First condition: $(x - 2)/(y - 6) = 1/3$. Second condition: $x/(y - 6) = 1/2$, so $2x = y - 6$. From (1): $36 - 3y = y - 12$, so $y = 24$. From (2): $2x = 18$, so $x = 9$. The fraction is $9/24 = 3/8$. Check: $12/(24 - 6) = 12/18 = 2/3$. Do not reduce it.

Q15. A taxi charges a fixed amount plus a variable amount per km. A 10 km ride costs Rs 155. Find the fixed charge and the rate per km. Write the equation in the form $y = mx + c$, and find the fare for 25 km.

Let the fixed charge be Rs f and the rate per km be Rs k . For 10 km: $f + 10k = 155$. For 25 km: $f + 25k = 205$. Subtract (1) from (2): $15k = 50$, so $k = 10/3$. From (1): $f = 155 - 10(10/3) = 155 - 100/3 = 355/3$. The equation is $y = (10/3)x + 355/3$. For 25 km: $y = 10(25) + 5 = 255$.



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Common Mistakes and Examiner Tips

1. **Saying one linear equation in two variables has a unique solution.** It has infinitely many. A unique solution needs a pair of equations whose lines intersect.
2. **Calling $y = 4$ or $x = -3$ "not an equation in two variables".** They are, with $a = 0$ or $b = 0$. Only $a = b = 0$ together is ruled out.
3. **Forgetting to change the sign when a term crosses the equals sign.** $3x = 2y - 4$ becomes $3x - 2y + 4 = 0$, so $c = +4$, not -4 . Write the full standard form before reading a , b , c .
4. **Dividing only some terms when making y the subject.** From $3x + 2y = 8$, $2y = -3x + 8$ gives $y = -(3/2)x + 4$. Dividing only the 8 by 2 gives the wrong line. Divide every term.
5. **Getting the slope sign wrong.** For $ax + by + c = 0$ the slope is $-a/b$, with a minus sign. For $2x + y = 6$ the slope is -2 , so the line falls.
6. **Joining points when x and y must be whole numbers.** If the context counts pens, people or runs, draw separate dots on the line and do not join them.
7. **Using the ratio test with equations in $ax + by + c = 0$ first, with c on the left.** Mixing a and b can give a wrong verdict.
8. **Checking only $a_1/a_2 = b_1/b_2$ for "no solution".** If $a_1/a_2 = b_1/b_2 \neq c_1/c_2$, there are infinitely many solutions.
9. **Adding one side and subtracting the other.** Always do the same to the right sides. Write the steps. You can follow your step.
10. **Stopping at x and y in word problems.** Check the solution against the original sentences.



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Quick Revision Points

- A linear equation in two variables has the form $ax + by + c = 0$, where a and b are not both zero.
- $y = k$ and $x = k$ are linear equations in two variables.
- A solution is an ordered pair (x, y) that satisfies the equation.
- One linear equation in two variables has infinitely many solutions.
- $x = k$ is parallel to the y -axis; $y = k$ is parallel to the x -axis.

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- Slope-intercept form: $y = mx + c$ (the syllabus writes $y = ax + b$). m is the slope, c is the y-intercept.
- From $ax + by + c = 0$ with $b \neq 0$: slope = $-a/b$, y-intercept = $-c/b$.
- Slope through two points: $(y_2 - y_1)/(x_2 - x_1)$. Positive slope rises, negative slope falls, zero slope is horizontal.
- When x and y can only be whole numbers, the graph is a set of separate points on the line.
- A pair of linear equations is two linear equations in the same two variables; its solution satisfies both.
- Intersecting lines: one solution, consistent. Parallel lines: no solution, inconsistent. Coincident lines: infinitely many solutions, consistent (dependent).
- Ratio test: $a_1/a_2 \neq b_1/b_2$ gives one solution; $a_1/a_2 = b_1/b_2 \neq c_1/c_2$ gives none; all three equal gives infinitely many.
- Substitution: make one variable the subject, substitute into the other equation, solve, back-substitute.
- Elimination: make one variable's coefficient the same, subtract, substitute.
- In elimination, $0 =$ a non-zero number means no solution.



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Weightage and Exam Pattern

Class 9 has no board exam. This chapter is not in the CBSE Class IX Mathematics course. Linear Equations in Two Variables sits in **Unit II, Algebra, which carries 20 marks**. This 20 is shared by four chapters: Introduction to Algebra, Exploring Algebraic Identities, and Linear Equations in Two Variables. The chapter does not give a separate mark for this chapter. The 20 marks of the year are internal assessment (portfolio 5, lab practical 5).

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Unit	Marks (out of 80)
I. Number System	07
II. Algebra	20
III. Coordinate Geometry	04
IV. Geometry	25
V. Mensuration	14
VI. Statistics and Probability	10

The CBSE question paper design weights questions by typology: about 54% remembering and understanding (for example, writing an equation in standard form, checking a solution, stating the nature of a pair), about 24% applying and about 22% analysing, evaluating and finding and correcting errors).

The course structure lists these key concepts: graphical representation of solutions, take only certain values, pairs of linear equations, inconsistency, and the substitution and elimination method. Chapter 10 chapter Pair of Linear Equations in Two



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