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CHAPTER NOTES

Pair of Linear Equations in Two Variables Class 10 Notes | CBSE Maths Chapter 7

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Hi, I am **Ira**. I teach this syllabus all day, so **Pair of 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 Pair of Linear Equations in Two Variables simply

What can the board exam ask?

Most important formulas

Quiz me on this chapter



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Pair of Linear Equations in Two Variables Class 10 Notes | CBSE Maths Chapter 3

Pair of Linear Equations in Two Variables is Chapter 3 of CBSE Class 10 Maths. It builds on the Class 9 idea of a single linear equation in x and y and looks for the values of x and y that satisfy two such equations at the same time. The chapter shows that each equation is a straight line, so a pair of equations is a pair of lines that can intersect, be parallel or coincide.

You learn three ways to handle a pair: the graphical method, the substitution method and the elimination method, plus a quick test that compares the ratios of the coefficients to tell whether a pair has one solution, no solution or infinitely many. For board exams the chapter matters because its questions follow fixed methods and every answer can be checked by putting the values back into both equations. Word problems on ages, digits, fractions, prices and fixed charges come straight from this chapter.

Quick Answer - Pair of Linear Equations

A pair of linear equations is $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$. If the lines **intersect**, there is one solution (consistent pair). If they **coincide**, there are infinitely many solutions (consistent pair). Compare a_1/a_2 , b_1/b_2 and c_1/c_2 . Solve by graph, by **substitution** or **elimination** (make one coefficient equal in both equations).



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All Key Formulas at a Glance

Idea	Formula or rule	What it tells you
General form of the pair	$a_1x + b_1y + c_1 = 0, a_2x + b_2y + c_2 = 0$	Read off a, b, c for each equation
Intersecting lines	$a_1/a_2 \neq b_1/b_2$	Exactly one solution, consistent pair
Coincident lines	$a_1/a_2 = b_1/b_2 = c_1/c_2$	Infinitely many solutions, dependent (consistent) pair
Parallel lines	$a_1/a_2 = b_1/b_2 \neq c_1/c_2$	No solution, inconsistent pair
Substitution method	From one equation, express one variable in terms of the other and substitute it in the other equation	
Elimination method	Multiply to make coefficients of one variable numerically equal and then add or subtract the equations	
True statement with no variable (e.g. $18 = 18$)	Appears in the process of elimination	
False statement with no variable (e.g. $0 = 9$)	Appears in the process of elimination	
Two-digit number	Tens digit x, units digit y, number = $10x + y$, reverse = $10y + x$	



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Key Concepts

1. Linear Equations in Two Variables and a Pair of Them

A **linear equation in two variables** is an equation that can be written as $ax + by + c = 0$, where a , b and c are real numbers and a and b are not both zero. Each variable appears only to the power 1. There is no x^2 , no xy and no $1/x$. So $3x + 4y = 20$ is linear, while $x^2 + y = 5$ and $xy = 6$ are not.

A **pair of linear equations in two variables** is two such equations in the same two variables, taken together. The general form of a pair is:

$$a_1x + b_1y + c_1 = 0$$

$$a_2x + b_2y + c_2 = 0$$

Here a_1 , b_1 , c_1 are the coefficients of the first equation and a_2 , b_2 , c_2 those of the second. A **solution** of the pair is a pair of values (x, y) that satisfies **both** equations at the same time. One equation alone has infinitely many solutions for both.

Where a pair comes from. The chapter opens with a story about a girl who goes to the Giant Wheel and plays Hoopla. The number of times she goes on the Giant Wheel is y and the number of rides on the Hoopla is x . Each ride on the Hoopla costs ₹2. The number of rides be x and the number of times on the Giant Wheel be y . The equations:

- "Hoopla is half the rides": $y = x/2$
- "She spent ₹20": $3x + 4y = 20$

Two unknowns need two separate conditions. Solving this pair gives $x = 4$ and $y = 2$.

2. Graphical Meaning: Three Possibilities

The graph of every linear equation in two variables is shown by **two lines** on the same axes. Every point that lies on **both** lines is a solution of the pair of equations.



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How the lines behave	Number of solutions	Name of the pair
Intersect in a single point	Exactly one (unique) solution: the point of intersection	Consistent
Parallel (never meet)	No solution	Inconsistent
Coincident (one lies exactly on the other)	Infinitely many solutions: every point on the line	Dependent (and consistent)

The textbook's definitions are worth learning word for word:

- A pair of linear equations which has **no solution** is called an **inconsistent** pair.
- A pair of linear equations in two variables which **has a solution** is called a **consistent** pair.
- A pair of linear equations which are equivalent has infinitely many distinct common solutions. Such a pair is called a **dependent** pair.

"Equivalent" means one equation is a non-zero multiple of the other. For example, $2x + 3y - 6 = 0$ and $4x + 6y - 12 = 0$ are equivalent, because the second equation is just twice the first. Both equations describe the same line, so every solution of one is a solution of the other.

3. Solving a Pair Graphically

To solve a pair by graph, draw both lines on a Cartesian plane. The point where they meet is the solution. For each equation:

1. Rewrite it to give y in terms of x (or x in terms of y).
2. Choose at least two convenient values for x (or y) and find the corresponding y (or x) values. Check. Values that give whole numbers are best. These are the points where the line cuts the axes.
3. Plot the points and join them with a straight line.

Then look at the two lines. If they meet at a single point, the pair is consistent. If they are parallel, there is no solution. If they lie on top of each other, the pair is dependent.

Worked illustration (NCERT Example 1). Solve the pair of linear equations graphically. Is the pair consistent, and if so, solve.



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$x + 3y = 6$, so $y = (6 - x)/3$			$2x - 3y = 12$, so $y = (2x - 12)/3$		
x	0	6	x	0	3
y	2	0	y	-4	-2

Plot A(0, 2) and B(6, 0) and join them to get line AB. Plot P(0, -4) and Q(3, -2) and join them to get line PQ. The point B(6, 0) is common to both lines. So the solution is $x = 6$, $y = 0$, and the pair is consistent. Check: $6 + 3(0) = 6$ and $2(6) - 3(0) = 12$.

Limitation of the graph. The graphical method is not convenient when the solution has non-integral coordinates such as (-1.75, 3.3) or (4/13, 1/19). Such points are hard to read exactly and mistakes are likely. That is why the algebraic methods come next.

4. Comparing Ratios of Coefficients

You can tell which of the three cases a pair of linear equations falls into by comparing the ratios a_1/a_2 , b_1/b_2 and c_1/c_2 . The textbook builds on this (Table 3.1):

Pair	a_1/a_2	b_1/b_2	c_1/c_2
$x - 2y = 0$ $3x + 4y - 20 = 0$	$1/3$	$-2/4$	$0/(-20)$
$2x + 3y - 9 = 0$ $4x + 6y - 18 = 0$	$2/4$	$3/6$	$-9/-18$
$x + 2y - 4 = 0$ $2x + 4y - 12 = 0$	$1/2$	$2/4$	$-4/-12$

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

- $a_1/a_2 \neq b_1/b_2$: the lines intersect, one unique solution



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- $a_1/a_2 = b_1/b_2 = c_1/c_2$: the lines coincide, infinitely many solutions, dependent and consistent.
- $a_1/a_2 = b_1/b_2 \neq c_1/c_2$: the lines are parallel, no solution, inconsistent.

The textbook adds that the converse is also true for any pair of lines. So if the first two ratios are equal and the third is different, the lines must be parallel, and the same holds for the other two cases.

Keep the signs. Always write the constant with its sign. In $3x + 4y - 20 = 0$, $c = -20$. If both equations are written in the form $ax + by = c$ instead, the constants both change sign, so the ratio c_1/c_2 stays the same. The comparison still works as long as both equations are written in the same form.

Finding an unknown coefficient. Many questions give a pair with a letter such as k and ask for the value of k that makes the pair consistent, inconsistent or dependent. Set up the right ratio condition and solve for k . For example, $x + 2y = 3$ and $5x + ky = 7$ have a unique solution when $1/5 \neq 2/k$, that is when $k \neq 10$.

5. Substitution Method

The substitution method removes one variable. It sets out three steps:

1. **Step 1:** From either equation, whichever is easier, solve for one variable in terms of the other, x .
2. **Step 2:** Substitute this value of y in the other equation. Solve it.
3. **Step 3:** Substitute the value of x from Step 2 into either equation. Solve for y .

Worked illustration (NCERT Example 4).

Step 1: from $x + 2y = 3$, $x = 3 - 2y$.

Step 2: put this in $7x - 15y = 2$: $7(3 - 2y) - 15y = 2$
 $21 - 14y - 15y = 2$
 $-29y = 2 - 21$
 $-29y = -19$
 $y = 19/29$.

Step 3: $x = 3 - 2(19/29) = 87/29 - 38/29 = 49/29$.

Solution: $x = 49/29$, $y = 19/29$. Check in the first equation:
 $49/29 + 2(19/29) = 49/29 + 38/29 = 87/29 = 3$.

When the variable disappears. Sometimes a pair of linear equations in two variables may have no solution or infinitely many solutions. This happens when the two lines are parallel or coincident.



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- If the statement is **true** (like $18 = 18$), the pair has **infinitely many solutions**. In NCERT Example 6, $2x + 3y = 9$ and $4x + 6y = 18$ (the cost of pencils and erasers) give $18 - 6y + 6y = 18$, that is $18 = 18$. The two equations are the same, so no unique cost can be found.
- If the statement is **false** (like $-4 = 0$), the pair has **no solution**. In NCERT Example 7, the rails $x + 2y - 4 = 0$ and $2x + 4y - 12 = 0$ give $2(4 - 2y) + 4y - 12 = 0$, that is $8 - 12 = 0$, or $-4 = 0$. So the rails will not cross each other.

6. Elimination Method

The elimination method removes (eliminates) one variable by making its coefficients equal in both equations and then adding or subtracting. It is sometimes more convenient than substitution, especially when no coefficient is 1. The textbook's steps:

1. **Step 1:** Multiply both equations by suitable non-zero constants so that the coefficients of one variable (x or y) become numerically equal.
2. **Step 2:** Add or subtract one equation from the other so that this variable is eliminated. If you get an equation in one variable, go to Step 3. If you get a contradiction, the pair has infinitely many solutions. If you get a true statement, the pair has no solution (inconsistent).
3. **Step 3:** Solve the equation in one variable.
4. **Step 4:** Substitute this value into either equation to find the other variable.

Adding or subtracting. If the equal coefficients have **opposite signs**, add. For example, in $3x + 2y = 10$ and $2x - 2y = 10$, so adding gives $5x = 20$ and $x = 4$.

Worked illustration (NCERT Example 8). The ratio of their expenditures is $4 : 3$. Each saves ₹1000 and the expenditures ₹4y and ₹3y. Saving

$$9x - 4y = 2000 \quad (1)$$

$$7x - 3y = 2000 \quad (2)$$

Step 1: multiply (1) by 3 and (2) by 4 to make coefficients of y equal.
 $28x - 12y = 8000 \quad (4)$.

Step 2: subtract (3) from (4): $x = 2000$.

Step 3: substitute in (1): $9(2000) - 4y = 2000$

The monthly incomes are $9 \times 2000 = ₹18,000$

Verification: $18000 : 14000 = 9 : 7$. Expend



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7. Forming Equations from Word Problems

Many questions in this chapter are word problems. The method is always the same:

- 1. Name the two unknowns clearly, with units. For example, "let the cost of one bat be ₹x and one ball be ₹y".
- 2. Turn each condition into one equation.
- 3. Solve by substitution or elimination (or by graph if the question asks for it).
- 4. Answer in words, with units, and verify against the **original** conditions.

The common types and how to write their equations:

Type	How to set it up
Ages	Present ages x and y. "n years ago" means $x - n$ and $y - n$. "n years hence" means $x + n$ and $y + n$.
Two-digit numbers	Tens digit x, units digit y. "Digits differ by 2" gives $x - y = 2$ or $y - x = 2$.
Fractions	Let the fraction be $\frac{x}{y}$. Multiply numerator and denominator by a common factor to get a linear equation.
Fixed charge plus rate	Total = fixed charge + rate × quantity. For a library with a fixed charge of ₹10 and a rate of ₹3 per book: $10 + 3y = \text{Total}$
Costs and notes	Number of items and total cost. $50x + 100y = 2000$ (if x is a 50₹ item and y is a 100₹ item)
Ratios	Write the quantities in the ratio and use the condition. If x and y are in the ratio a:b, then $\frac{x}{y} = \frac{a}{b}$.
Geometry	Supplementary angles, perimeter, area, length + width.

Which method to use. A question may name the method. If not, pick substitution when a variable has coefficient 1, or elimination for larger numbers. Use the graph only when the question asks for the region.



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Formula and Theorem Sheet

Topic	Rule or result	Remember
Linear equation in two variables	$ax + by + c = 0$, a and b not both zero	Powers of x and y are 1; no xy term
General form of a pair	$a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$	Keep the sign of each coefficient
Solution of a pair	(x, y) satisfying both equations	Check by substituting in both
Intersecting lines	$a_1/a_2 \neq b_1/b_2$	Unique solution;
Coincident lines	$a_1/a_2 = b_1/b_2 = c_1/c_2$	
Parallel lines	$a_1/a_2 = b_1/b_2 \neq c_1/c_2$	
Substitution method	Express one variable in terms of the other, substitute in the other equation	
Elimination method	Equalise one coefficient, then add or subtract the equations	
No variable left, true statement	Example: $18 = 18$	
No variable left, false statement	Example: $0 = 9$	
Two-digit number	$10x + y$; reverse is $10y + x$	
Ages	n years ago: $x - n$; n years hence: $x + n$	



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Important Definitions

- **Linear equation in two variables:** an equation that can be written as $ax + by + c = 0$, where a , b , c are real numbers and a and b are not both zero.
- **Pair of linear equations in two variables:** two linear equations in the same two variables, considered together.
- **Solution of a pair:** a pair of values of x and y that satisfies both equations at the same time. On a graph, it is a point common to both lines.
- **Consistent pair:** a pair of linear equations in two variables which has a solution. Its lines intersect or coincide.
- **Inconsistent pair:** a pair of linear equations which has no solution. Its lines are parallel.
- **Dependent pair:** a pair of linear equations which are equivalent, and so have infinitely many distinct common solutions. Its lines coincide. A dependent pair is always consistent.
- **Unique solution:** exactly one solution, which happens when the two lines intersect in a single point.
- **Substitution method:** solving a pair by one equation and substituting it into the other.
- **Elimination method:** solving a pair by making coefficients of one variable equal and then adding or subtracting the equations.

Solved Examples (NCERT)

Example 1: Pencils and pens, solve

Question: Form the pair of linear equations for the following problem and solve graphically: 5 pencils and 7 pens together cost ₹46. Find the cost of one pencil and that of one pen.

Solution: Let one pencil cost ₹ x and one pen cost ₹ y .
 $5x + 7y = 46$.



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5x + 7y = 50				7x + 5y = 46			
x	3	10	-4	x	3	8	-2
y	5	0	10	y	5	-2	12

Plot both sets of points and draw the two lines. They intersect at (3, 5). So one pencil costs ₹3 and one pen costs ₹5. Check: $5(3) + 7(5) = 15 + 35 = 50$ and $7(3) + 5(5) = 21 + 25 = 46$.

Example 2: Intersecting, parallel or coincident (NCERT Exercise 3.1)

Question: On comparing the ratios a_1/a_2 , b_1/b_2 and c_1/c_2 , find out whether the lines representing the following pairs of linear equations intersect at a point, are parallel or coincident: (i) $5x - 4y + 8 = 0$, $7x + 6y - 9 = 0$ (ii) $9x + 3y + 12 = 0$, $18x + 6y + 24 = 0$ (iii) $6x - 3y + 10 = 0$, $2x - y + 9 = 0$

Solution:

- (i) $a_1/a_2 = 5/7$ and $b_1/b_2 = -4/6 = -2/3$.
- (ii) $9/18 = 1/2$, $3/6 = 1/2$, $12/24 = 1/2$. All
- (iii) $6/2 = 3$, $-3/-1 = 3$, $10/9$. The first two are parallel.

Example 3: Consistency check, the

Question: Which of the following pairs of consistent, obtain the solution graphically:

Solution: $a_1/a_2 = 2/4 = 1/2$ and $b_1/b_2 = 1/(-$ and the pair is consistent.

For $2x + y = 6$, $y = 6 - 2x$: points (0, 6), (3, 0), (1, 0), (2, 2). Both lists contain (2, 2), so the pair is consistent. $2 - 6 = 0$ and $4(2) - 2(2) - 4 = 0$.

Example 4: Writing a second equation

Question: Given the linear equation $2x + 3y = 6$, write two more linear equations in two variables such that the geometrical representation is (i) intersecting lines (ii) parallel lines (iii) coincident lines.



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Solution: Here $a_1 = 2$, $b_1 = 3$, $c_1 = -8$.

- (i) Intersecting: we need $a_1/a_2 \neq b_1/b_2$. Take $3x + 2y - 7 = 0$: $2/3 \neq 3/2$.
- (ii) Parallel: multiply the x and y coefficients by the same number but not the constant. Take $4x + 6y - 8 = 0$: $2/4 = 3/6 = 1/2$ but $-8/-8 = 1$.
- (iii) Coincident: multiply the whole equation by one number. Take $6x + 9y - 24 = 0$: $2/6 = 3/9 = -8/-24 = 1/3$.

Many answers are possible. Any equation that meets the ratio condition is correct.

Example 5: Triangle formed with the x-axis (NCERT Exercise 3.1)

Question: Draw the graphs of the equations $x - y + 1 = 0$ and $3x + 2y - 12 = 0$. Determine the coordinates of the vertices of the triangle formed by these lines and the x-axis, and shade the triangular region.

Solution: For $x - y + 1 = 0$, $y = x + 1$: point $(-1, 0)$. For $3x + 2y - 12 = 0$, $y = (12 - 3x)/2$: points $(4, 0)$, $(0, 6)$, $(2, 3)$.

The two lines meet at $(2, 3)$, since $(2, 3)$ is a solution of both equations. The first line cuts the x-axis (where $y = 0$) at $(-1, 0)$.

The vertices of the triangle are $(2, 3)$, $(-1, 0)$, and $(4, 0)$. The base of the triangle is the line segment on the x-axis between $x = -1$ and $x = 4$, which has a length of 5 units. The height is 3 units, so its area is $(1/2) \times 5 \times 3 = 7.5$ square units.

Example 6: Solve, then find m (NCERT Exercise 3.2)

Question: Solve $2x + 3y = 11$ and $2x - 4y = -3$.

Solution: From the first equation, $2x = 11 - 3y$. Substituting this in the second equation, $11 - 3y - 4y = -3$, so $11 - 7y = -3$, $-7y = -35$ and $y = 5$. The value of x is $(11 - 3 \times 5)/2 = -2$.

Now $y = mx + 3$ gives $5 = m(-2) + 3$, so $-2m = 2$ and $m = -1$.

Example 7: Taxi charges (NCERT Exercise 3.3)

Question: The taxi charges in a city consist of a fixed charge plus a charge for the distance covered. For a distance of 10 km, the charge is Rs. 15. For a distance of 20 km, the charge is Rs. 20. Find the fixed charge and the charge per km.



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charge paid is ₹155. What are the fixed charges and the charge per km? How much does a person have to pay for travelling a distance of 25 km?

Solution: Let the fixed charge be ₹x and the charge per km be ₹y.

$$x + 10y = 105 \quad (1)$$

$$x + 15y = 155 \quad (2)$$

From (1), $x = 105 - 10y$. Substitute in (2): $105 - 10y + 15y = 155$, so $5y = 50$ and $y = 10$. Then $x = 105 - 100 = 5$.

The fixed charge is ₹5 and the charge per km is ₹10. For 25 km: $5 + 25 \times 10 = ₹255$.

Example 8: Finding the fraction (NCERT Exercise 3.2)

Question: A fraction becomes $\frac{9}{11}$, if 2 is added to both the numerator and the denominator. If 3 is added to both the numerator and the denominator, it becomes $\frac{5}{6}$.

Solution: Let the fraction be $\frac{x}{y}$.

$$\frac{(x + 2)}{(y + 2)} = \frac{9}{11} \text{ gives } 11x + 22 = 9y + 18$$

$$\frac{(x + 3)}{(y + 3)} = \frac{5}{6} \text{ gives } 6x + 18 = 5y + 15$$

Multiply (1) by 5 and (2) by 9: $55x - 45y = -9$, so $9y = 81$ and $y = 9$.

The fraction is $\frac{7}{9}$. Check: $\frac{9}{11}$ is correct,

Example 9: Jacob and his son (NCERT Exercise 3.2)

Question: Five years hence, the age of Jacob will be three times that of his son. Five years ago, Jacob's age was seven times that of his son.

Solution: Let Jacob's present age be x years and his son's present age be y years.

$$\text{Five years hence: } x + 5 = 3(y + 5), \text{ so } x - 3y = 10$$

$$\text{Five years ago: } x - 5 = 7(y - 5), \text{ so } x - 7y = -30$$

Subtract (2) from (1): $4y = 40$, so $y = 10$. Then $x = 35$.



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Jacob is **40 years** old and his son is **10 years** old. Check: in 5 years, $45 = 3 \times 15$. Five years ago, $35 = 7 \times 5$.

Example 10: Elimination with fractional answers (NCERT Exercise 3.3)

Question: Solve the following pair of linear equations by the elimination method and the substitution method: $3x - 5y - 4 = 0$ and $9x = 2y + 7$

Solution: Rewrite: $3x - 5y = 4$ (1) and $9x - 2y = 7$ (2).

Multiply (1) by 3: $9x - 15y = 12$ (3). Subtract (3) from (2): $(9x - 2y) - (9x - 15y) = 7 - 12$, so $13y = -5$ and $y = -5/13$.

From (1): $3x = 4 + 5y = 4 - 25/13 = 27/13$, so $x = 9/13$.

By substitution: from (1), $x = (4 + 5y)/3$. Put this in (2): $3(4 + 5y) - 2y = 7$, so $12 + 13y = 7$ and $y = -5/13$, the same value.

Solution: $x = 9/13$, $y = -5/13$. Check in (2):

Example 11: The digit problem (NCERT Exercise 3.4)

Question: The sum of the digits of a two-digit number is 9. When the number obtained by reversing the order of the digits is added to the original number, the sum is 108. Find the number.

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

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

$$9(10x + y) = 2(10y + x), \text{ so } 90x + 9y = 20y + 2x$$

Substitute (2) in (1): $x + 8x = 9$, so $x = 1$ and $y = 8$. The number is $10x + y = 10 + 8 = 18$.

Competency-Based Questions

1. Case-based: Akhila at the fair

Akhila went to a fair. The number of times she rode the Giant Wheel is twice the number of times she played Hoopla. Each ride costs ₹3 and a game of Hoopla costs ₹4. She spent ₹20 in all.



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(a) Write the pair of equations, taking x rides and y Hoopla games. (b) Solve the pair. (c) If she had spent ₹30 with the same rule, how many rides would she have had?

Answer: (a) $y = x/2$ and $3x + 4y = 20$. (b) Substituting, $3x + 2x = 20$, so $x = 4$ and $y = 2$. (c) $3x + 2x = 30$ gives $x = 6$ rides (and 3 Hoopla games). Check: $18 + 12 = 30$.

2. Case-based: The gym membership

A gym charges a one-time joining fee plus a fixed fee for every month. Riya paid ₹4,100 in total for 3 months. Kabir paid ₹8,500 in total for 7 months.

(a) Form the pair of equations. (b) Find the joining fee and the monthly fee. (c) How much would a 12-month membership cost in total?

Answer: (a) Let the joining fee be ₹ x and the monthly fee ₹ y . Then $x + 3y = 4100$ and $x + 7y = 8500$. (b) Subtracting: $4y = 4400$, so $y = 1100$. Then $x = 4100 - 3300 = 800$. The joining fee is ₹800 and the monthly fee is ₹1,100. (c) 8000

3. Source-based: Will the rails cross

In NCERT Example 7, two rails are represented by the equations $2x + 4y - 8 = 0$. Substituting $x = 4 - 2y$ into the second equation, we get $8 - 4y - 8 = 0$, which simplifies to $-4y = 0$, so $y = 0$ and $x = 4$. This means the two rails intersect at the point $(4, 0)$.

(a) What does the false statement tell you about the ratios of coefficients. (c) Change the constant term of the second equation so that the two rails are parallel. What would the new equation be?

Answer: (a) A false statement with no variables will not cross each other; they are parallel. (b) $b_1/b_2 \neq c_1/c_2$: parallel lines, inconsistent pair. (c) -8 . The second rail would be $2x + 4y - 8 = 0$.

4. Assertion-Reason

Assertion (A): The pair $x + 2y = 3$ and $2x + 4y = 6$ has infinitely many solutions.

Reason (R): If $a_1/a_2 = b_1/b_2 = c_1/c_2$, the lines are coincident and have infinitely many solutions.

- (a) Both A and R are true, and R is the correct reason for A.
(b) Both A and R are true, but R is not the correct reason for A.
(c) A is true, but R is false.
(d) A is false, but R is true.



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Answer: (a). The ratios are $1/2$, $2/4$ and $3/6$, all equal to $1/2$, so A is true. R is the correct rule, and it is exactly the reason A holds.

5. Assertion-Reason

Assertion (A): The pair $2x + 3y = 5$ and $4x + 6y = 11$ has a unique solution.

Reason (R): If $a_1/a_2 = b_1/b_2 \neq c_1/c_2$, the lines representing the pair are parallel.

- (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: (d). Here $2/4 = 3/6 = 1/2$ but $5/11 \neq 1/2$. The lines are parallel, so the pair has no solution and A is false. R is a true statement of the rule.

6. Assertion-Reason

Assertion (A): The graph of a dependent pair of linear equations is a line.

Reason (R): A dependent pair of linear equations represents a line.

- (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). A is true: the equations of a dependent pair of linear equations represent the same line. R is also true, as stated in the text. However, the reason R is not the correct explanation of A is that intersecting lines are consistent too.

7. Error analysis: The sign slip

A student solves $3x + 2y = 11$ and $2x + 3y = 10$ by multiplying the first equation by 2 and the second by 2: $9x + 6y = 33$ and $4x + 6y = 20$. He subtracts the second equation from the first and gets $5x = 13$, so $x = 13/5$. He then finds $y = 10/5 = 2$. The error is in the sign of the constant term in the second equation. The correct equations are $3x + 2y = 11$ and $2x + 3y = 10$. The correct solution is $x = 1$ and $y = 2$.

Answer: The y-coefficients are both +6y, so they should be subtracted. Adding leaves 12y in the result. Correct step: $(9x + 6y) - (4x + 6y) = 33 - 20$ and $y = -2$. Check: $2(5) + 3(-2) = 10 - 6 = 4$.



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8. Competency MCQ: Value of k for no solution

For which value of k does the pair $kx + 3y = k - 3$ and $12x + ky = k$ have no solution?

(A) 6 (B) -6 (C) ± 6 (D) 0

Answer: (B) -6. No solution needs $k/12 = 3/k \neq (k - 3)/k$. From $k/12 = 3/k$, $k^2 = 36$, so $k = 6$ or $k = -6$. For $k = 6$: the ratios are $1/2$, $1/2$ and $3/6 = 1/2$, all equal, so the lines coincide (infinitely many solutions). Reject 6. For $k = -6$: the ratios are $-1/2$, $-1/2$ and $-9/-6 = 3/2$, so the third is different and the lines are parallel. Only $k = -6$ works.

Important Questions for Board Exams

1-Mark Questions

1. For what value of k is the pair $2x + 3y = 7/14$. So $3/k = 1/2$ and $k = 6$.
2. Is the pair $x - 2y = 0$ and $3x + 4y - 20 = 0$ it is consistent with a unique solution.
3. How many solutions does a pair of line pair is inconsistent.



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2-Mark Questions

1. Half the perimeter of a rectangular garden is 36 m. Find the dimensions of the garden. $2l + w = 36$. Substituting: $2w + 4 = 36$, so $w = 16$ and $l = 10$.
2. The larger of two supplementary angles is 18 degrees more than the smaller. Find the angles. $y = 180$ and $x - y = 18$. Adding: $2x = 198$, $x = 99$, $y = 81$.
3. Solve the following pair of linear equations by the elimination method: $3x + 4y = 10$ and $2x - 2y = 2$.
1. Then $3(y + 1) + 4y = 10$, $7y = 7$, $y = 1$ and $x = 2$.
2. Then $3x + 4(y - 1) = 10$, $3x + 4y - 4 = 10$, $3x + 4y = 14$. Subtract $3x + 4y = 10$ from $3x + 4y = 14$ to get $4 = 4$. Add it to $3x + 4y = 10$: $2x = 6$, $x = 3$.
3. Then $3(3) + 4y = 10$, $9 + 4y = 10$, $4y = 1$, $y = 1/4$.
4. Then $2x - 2y = 2$, $2(3) - 2(1/4) = 2$, $6 - 1/2 = 2$, $11/2 = 2$, which is not true. So the system has no solution.
4. Find k for which $kx + 2y = 5$ and $3x + y = k$ and then $2 \neq 5$ holds. $k = 6$.

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3-Mark Questions

- Five years ago, Nuri was thrice as old as Sonu. Ten years later, Nuri will be twice as old as Sonu. How old are Nuri and Sonu?** Let their present ages be x and y . $x - 5 = 3(y - 5)$ gives $x - 3y = -10$. $x + 10 = 2(y + 10)$ gives $x - 2y = 10$. Subtract the first from the second: $y = 20$. Then $x = 10 + 2(20) = 50$. Nuri is 50 years and Sonu is 20 years. Check: $45 = 3 \times 15$ and $60 = 2 \times 30$.
- Find a and b for which $2x + 3y = 7$ and $(a - b)x + (a + b)y = 3a + b - 2$ have infinitely many solutions.** Need $2/(a - b) = 3/(a + b) = 7/(3a + b - 2)$. From the first two: $2a + 2b = 3a - 3b$, so $a = 5b$. Then $a + b = 6b$ and $3a + b - 2 = 16b - 2$. From $3/(6b) = 7/(16b - 2)$: $3(16b - 2) = 42b$, so $48b - 6 = 42b$ and $b = 1$. Then $a = 5$. Check: the ratios are $2/4$, $3/6$ and $7/14$, all $1/2$.
- A lending library has a fixed charge for the first three days and an additional charge for each day thereafter. Saritha paid ₹27 for a book kept for seven days, while Susy paid ₹21 for the book she kept for five days. Find the fixed charge and the charge for each extra day.** Let the fixed charge be ₹ x and the extra charge ₹ y per day. Seven days means 4 extra days: $x + 4y = 27$. Five days means 2 extra days: $x + 2y = 21$. Subtract: $2y = 6$, $y = 3$. Then $x = 21 - 6 = 15$. Fixed charge ₹15, extra ₹3 per day.

5-Mark Questions

- Solve graphically: $2x + y = 6$ and $2x - y = -2$. Find the area of the triangle formed by these lines and the x -axis, and its area.** For $2x - y + 2 = 0$, $y = 2x + 2$: points $(0, 2)$ and $(-1, 0)$. The vertices of the triangle are $(0, 2)$, $(-1, 0)$ and $(-3, 0)$. Height = 4 units, area = $(1/2) \times 4 \times 4 = 8$.
- If we add 1 to the numerator and subtract 1 from the denominator, the fraction becomes $1/2$ if we only add 1 to the denominator, the fraction becomes $1/3$. Find the fraction.** Let the fraction be x/y . $(x + 1)/(y - 1) = 1/2$ and $x/(y + 1) = 1/3$. $2(x + 1) = y - 1$ and $3x = y + 1$. $2x + 2 = y - 1$, so $x - y = -3$. $3x = y + 1$, so $3x - y = 1$. Subtract: $4x = -4$, $x = -1$. Then $y = -4 - x = -3$. The fraction is $1/2$.



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Common Mistakes and Ex

- Adding when you should subtract in elimination method.** When signs are the same, subtract; when opposite, add. Look for the same sign, subtract; when opposite, add. Look for the same sign, subtract; when opposite, add.

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2. **Distributing a minus sign wrongly.** In $(9x - 2y) - (9x - 15y)$, the second bracket becomes $-9x + 15y$. Write the bracket out on its own line before simplifying.
3. **Dropping the sign of c in the ratio test.** In $x + 2y - 4 = 0$, $c_1 = -4$, not 4. Write both equations in the same form first and keep every sign.
4. **Comparing only two ratios for coincident lines.** $a_1/a_2 = b_1/b_2$ only says the lines are parallel or coincident. You must check c_1/c_2 to decide which.
5. **Calling a coincident pair inconsistent.** Coincident lines have infinitely many solutions, so the pair is dependent and consistent. Only parallel lines give an inconsistent pair.
6. **Shifting only one person's age.** "Five years ago" applies to both people: $x - 5$ and $y - 5$. The same goes for "ten years later".
7. **Writing a two-digit number as $x + y$ or xy .** The number with tens digit x and units digit y is $10x + y$. Its reverse is $10y + x$.
8. **Missing the second case in digit problems.** "The digits differ by 2" allows $x - y = 2$ and $y - x = 2$. NCERT Example 10 has two answers: 42 and 24.
9. **Counting all days in the library problem.** 4 extra days means 4 extra days, not 7.
10. **Plotting only two points and misdrawing lines.** Draw more than two number points, label each line with its equation and coordinates.
11. **Stopping at x and y.** Answer the question in the original words, not only in your equation. Do an equation-only check.



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Quick Revision Points

- A linear equation in two variables has the form $ax + by + c = 0$.
- A pair of linear equations: $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$.
- A solution of the pair satisfies both equations.
- The graph of each equation is a straight line.
- Intersecting lines: unique solution, consistent.
- Parallel lines: no solution, inconsistent.
- Coincident lines: infinitely many solutions, consistent.
- A dependent pair is always consistent.

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- $a_1/a_2 \neq b_1/b_2$: intersecting.
- $a_1/a_2 = b_1/b_2 = c_1/c_2$: coincident.
- $a_1/a_2 = b_1/b_2 \neq c_1/c_2$: parallel.
- Graphical method: two or three points per line, read the point of intersection.
- The graph is inconvenient for non-integral solutions such as $(4/13, 1/19)$.
- Substitution: express one variable in terms of the other, substitute, solve, back-substitute.
- Elimination: equalise one coefficient, add or subtract, solve, back-substitute.
- Same signs: subtract. Opposite signs: add.
- True statement with no variable: infinitely many solutions. False statement: no solution.
- Two-digit number: $10x + y$; reversed: $10y + x$.
- Ages: shift both people by the same number of years.
- For a parallel partner line, scale a and b but not c ; for a coincident one, scale all three.

Weightage in Board Exam

Pair of Linear Equations in Two Variables k
with Polynomials, Quadratic Equations and
course structure for the marks given to the
predictable way.



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Question type	What is usually asked
MCQ and Assertion-Reason	Ratio test for intersecting, parallel or coincident lines; the value of k for a unique solution, no solution or infinitely many; whether a given pair of values is a solution
Short answers	Solving a pair by substitution or elimination; writing a second equation for a given type of line; a short word problem on angles, perimeter or prices
Long answer	A graphical solution with a triangle formed with an axis; word problems on ages, digits, fractions, fixed charges or notes
Case-based	A real situation such as fees, prices or a fair: form the pair, solve it and interpret the answer

In every question, marks go to forming the equations, solving them, checking the solution asked for, and stating the final answer in words. In some questions, you may also get the k -value and graph-with-triangle to



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