

EXERCISE 3.1

Question 1:

Form the pair of linear equations in the following problems, and find their solutions graphically.

- (i) 10 students of Class X took part in a Mathematics quiz. If the number of girls is 4 more than the number of boys, find the number of boys and girls who took part in the quiz.

Solution:

(i) Let there are x number of girls and y number of boys. As per the given question, the algebraic expression can be represented as follows.

$$X + Y = 10$$

$$X - Y = 4$$

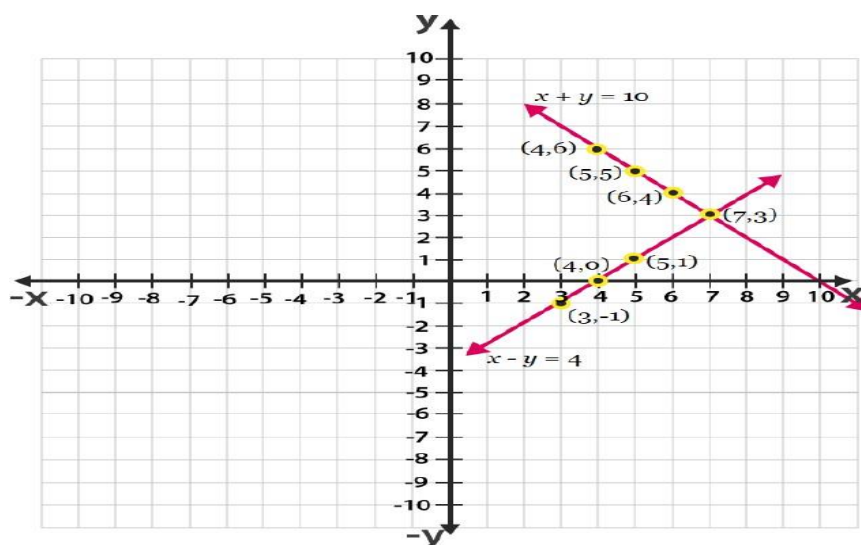
Now, for $x + y = 10$ or $x = 10 - y$, the solutions are;

x	5	4	6
y	5	6	4

For $x - y = 4$ or $x = 4 + y$, the solutions are;

x	4	5	3
y	0	1	-1

The graphical representation is as follows;



From the graph, it can be seen that the given lines cross each other at point $(7, 3)$. Therefore, there are 7 girls and 3 boys in the class.

- (ii) 5 pencils and 7 pens together cost 50, whereas 7 pencils and 5 pens together cost 46. Find the cost of one pencil and that of one pen.

Solution:

(ii) Let 1 pencil costs Rs. x and 1 pen costs Rs. y .

According to the question, the algebraic expression can be represented as;

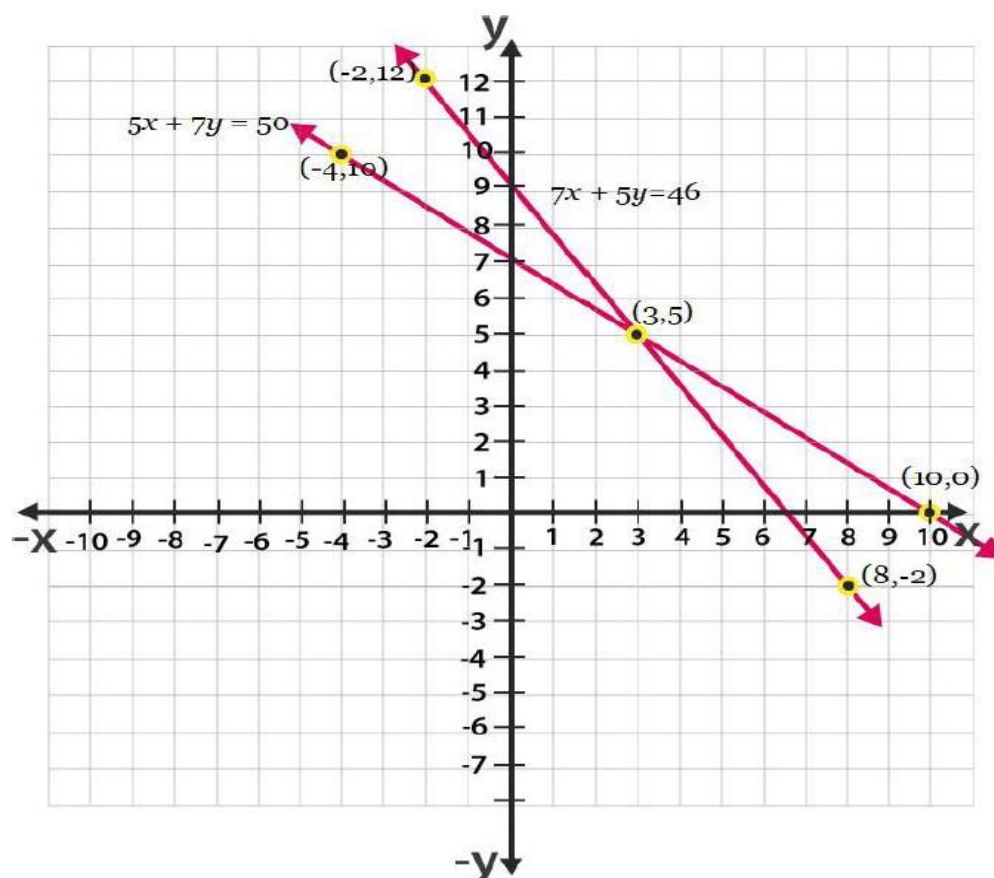
$$5x + 7y = 50$$

$$7x + 5y = 46$$

For $7x + 5y = 46$ or $x = (46-5y)/7$, the solutions are;

x	8	3	-2
y	-2	5	12

Hence, the graphical representation is as follows;



From the graph, it can be seen that the given lines cross each other at point $(3, 5)$.

So, the cost of a pencil is 3/- and cost of a pen is 5/-.

Question 2:

On comparing the ratios a_1/a_2 , b_1/b_2 , 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) $5x - 4y + 8 = 0$ and $7x + 6y - 9 = 0$

$$a_1 = 5, b_1 = -4, c_1 = 8$$

$$a_2 = 7, b_2 = 6, c_2 = -9$$

$$a_1/a_2 = 5/7 \dots (1)$$

$$b_1/b_2 = -4/6 = -2/3 \dots (2)$$

From (1) and (2)

$$a_1/a_2 \neq b_1/b_2$$

Therefore, they are intersecting lines at a point.

(ii) $9x + 3y + 12 = 0$ and $18x + 6y + 24 = 0$

$$a_1 = 9, b_1 = 3, c_1 = 12$$

$$a_2 = 18, b_2 = 6, c_2 = 24$$

$$a_1/a_2 = 9/18 = 1/2 \dots (1)$$

$$b_1/b_2 = 3/6 = 1/2 \dots (2)$$

$$c_1/c_2 = 12/24 = 1/2 \dots (3)$$

From (1), (2) and (3)

$$a_1/a_2 = b_1/b_2 = c_1/c_2 = 1/2$$

Therefore, they are coincident lines.

(iii) $6x - 3y + 10 = 0$ and $2x - y + 9 = 0$

$$a_1 = 6, b_1 = -3, c_1 = 10$$

$$a_2 = 2, b_2 = -1, c_2 = 9$$

$$a_1/a_2 = 6/2 = 3 \dots (1)$$

$$b_1/b_2 = -3/(-1) = 3 \dots (2)$$

$$c_1/c_2 = 10/9 \dots (3)$$

From (1), (2) and (3)

$$a_1/a_2 = b_1/b_2 \neq c_1/c_2 \text{ Therefore, they are parallel lines.}$$

Question 3:

On comparing the ratios a_1/a_2 , b_1/b_2 and c_1/c_2 , find out whether the following pair of linear equations are consistent, or inconsistent.

(i) $3x + 2y = 5$; $2x - 3y = 7$

$$3x + 2y = 5; 2x - 3y = 7$$

$$a_1/a_2 = 3/2$$

$$b_1/b_2 = 2/(-3)$$

$$c_1/c_2 = -5/(-7) = 5/7$$

From the above,

$$a_1/a_2 \neq b_1/b_2$$

Therefore, lines are intersecting and have a unique solution,

Hence, the pair of equations is consistent.

(ii) $2x - 3y = 8$; $4x - 6y = 9$

$$2x - 3y = 8; 4x - 6y = 9$$

$$a_1/a_2 = 2/4 = 1/2$$

$$b_1/b_2 = -3/(-6) = 1/2$$

$$c_1/c_2 = -8/(-9) = 8/9$$

From the above,

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

Therefore, these lines are parallel and have no solution,

Hence, the pair of equations is inconsistent.

(iii) $3/2x + 5/3y = 7$; $9x - 10y = 14$

$$3/2x + 5/3y = 7; 9x - 10y = 14$$

$$a_1/a_2 = (3/2)/9 = (3/2) \times (1/9) = 1/6$$

$$b_1/b_2 = (5/3)/(-10) = (5/3) \times 1/(-10) = 1/(-6) = -1/6$$

From the above,

$$a_1/a_2 \neq b_1/b_2$$

Therefore, lines are intersecting and have a unique solution.

Hence, they are consistent.

(iv) $5x - 3y = 11$; $-10x + 6y = -22$

$$5x - 3y = 11; -10x + 6y = -22$$

$$a_1/a_2 = 5/(-10) = -1/2$$

$$b_1/b_2 = -3/6 = -1/2$$

$$c_1/c_2 = -11/22 = -1/2$$

From the above,

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

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Therefore, lines are coincident and have infinitely many solutions.
Hence, they are consistent.

(v) $4/3x + 2y = 8$; $2x + 3y = 12$

$$4/3x + 2y = 8; 2x + 3y = 12$$

$$a_1/a_2 = (4/3)/2 = (4/3) \times (1/2) = 2/3$$

$$b_1/b_2 = 2/3$$

$$c_1/c_2 = -8/(-12) = 2/3$$

From the above,

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

Therefore, lines are coincident and have infinitely many solutions.

Hence, they are consistent.

Question 4:

Which of the following pairs of linear equations are consistent/inconsistent? If consistent, obtain the solution graphically:

(i) $x + y = 5$, $2x + 2y = 10$

(ii) $x - y = 8$, $3x - 3y = 16$

(iii) $2x + y - 6 = 0$, $4x - 2y - 4 = 0$

(iv) $2x - 2y - 2 = 0$, $4x - 4y - 5 = 0$

SOLUTIONS

(i)

$$x + y = 5, 2x + 2y = 10$$

$$a_1/a_2 = 1/2$$

$$b_1/b_2 = 1/2$$

$$c_1/c_2 = -5/(-10) = 1/2$$

From the above,

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

Therefore, lines are coincident and have infinitely many solutions. Hence, they are consistent.

$$x + y - 5 = 0$$

$$y = -x + 5$$

$$y = 5 - x$$

x	1	2
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$y = 5 - x$	4	3
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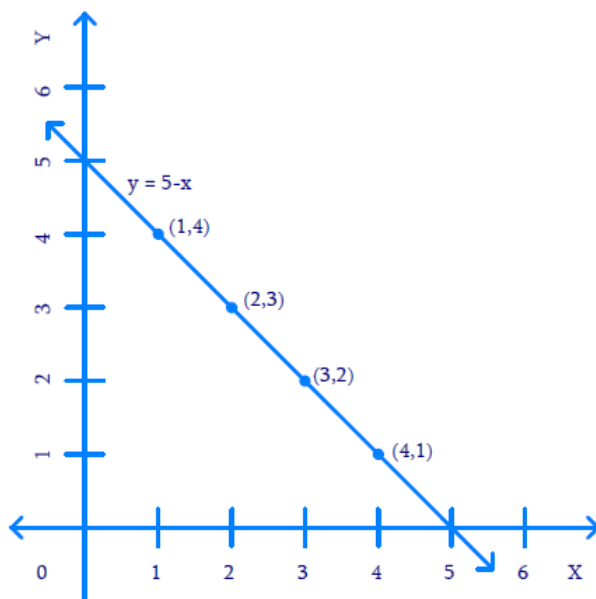
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$$2x + 2y - 10 = 0$$

$$2y = 10 - 2x$$

$$y = 5 - x$$

x	3	4
$y = 5 - x$	2	1



(ii) $x - y = 8, 3x - 3y = 16$

$$a_1/a_2 = 1/3$$

$$b_1/b_2 = -1/(-3) = 1/3$$

$$c_1/c_2 = -8/(-16) = 1/2$$

From the above,

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

Therefore, lines are parallel and have no solution.

Hence, the pair of equations are inconsistent.

(iii)

$$2x + y - 6 = 0, 4x - 2y - 4 = 0$$

$$a_1/a_2 = 2/4 = 1/2$$

$$b_1/b_2 = 1/(-2) = -1/2$$

$$c_1/c_2 = -6/(-4) = 3/2$$

From the above,

$$a_1/a_2 \neq b_1/b_2$$

Therefore, lines are intersecting and have a unique solution.

Hence, they are consistent.

$$2x + y - 6 = 0$$

$$y = 6 - 2x$$

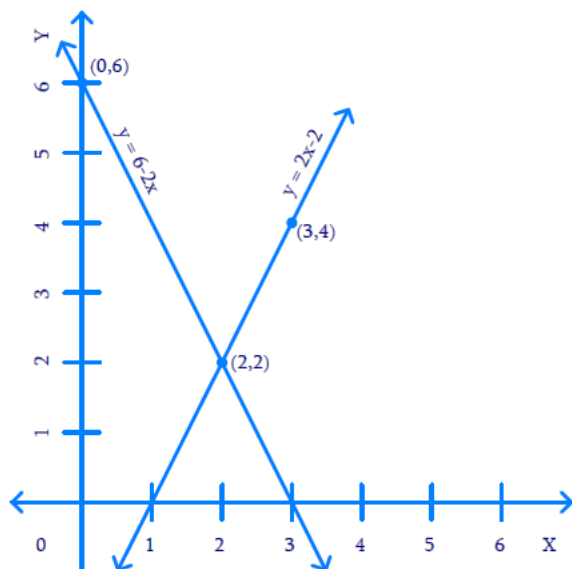
x	0	2
$y = 6 - 2x$	6	2

$$4x - 2y - 4 = 0$$

$$2y = 4x - 4$$

$$y = 2x - 2$$

x	2	3
$y = 2x - 2$	2	4



(iv)

$$2x - 2y - 2 = 0, 4x - 4y - 5 = 0$$

$$a_1/a_2 = 2/4 = 1/2$$

$$b_1/b_2 = -2/(-4) = 1/2$$

$$c_1/c_2 = -2/(-5) = 2/5$$

From the above,

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

Therefore, lines are parallel and have no solution.

Hence, the pair of equations are inconsistent

Question 5:

Half the perimeter of a rectangular garden, whose length is 4 m more than its width, is 36 m. Find the dimensions of the garden

Solutions:

Assuming the length of the garden as x and the width of the garden as y ,

Perimeter of rectangle = $2(\text{length} + \text{breadth})$

Let the length of the garden be x and breadth be y

Then $x = y + 4$ [Since its given that length is 4 m more than its width]

$$x - y = 4$$

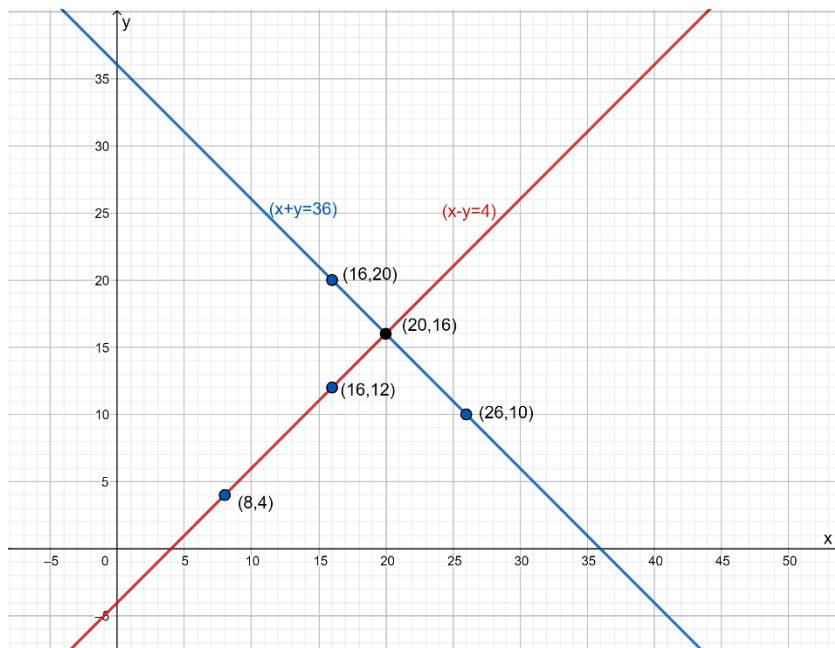
$$y = x - 4$$

x	8	16
$y = x - 4$	4	12

The half perimeter of the rectangle is $x + y = 36$ [Since, perimeter = $2(x + y)$]

$$y = 36 - x$$

x	16	26
$y = 36 - x$	20	10



Thus, Length, $x = 20$ m and Breadth, $y = 16$ m

Question 6:

Given the linear equation $2x + 3y - 8 = 0$, write another linear equation in two variables such that the geometrical representation of the pair so formed is:

- (i) intersecting lines
- (ii) parallel lines
- (iii) coincident lines

Solution:

(i) Intersecting lines

Condition: $a_1/a_2 \neq b_1/b_2$

$$2x + 3y - 8 = 0$$

$$a_1 = 2$$

$$b_1 = 3$$

So, considering $a_2 = 3$ and $b_2 = 2$ will satisfy the condition for intersecting lines. c_2 can be any value.

$$a_1/a_2 = 2/3$$

$$b_1/b_2 = 3/2$$

$$2/3 \neq 3/2$$

Therefore, another linear equation is $3x + 2y - 6 = 0$

(ii) Parallel linesCondition: $a_1/a_2 = b_1/b_2 \neq c_1/c_2$

$$2x + 3y - 8 = 0$$

$$a_1 = 2$$

$$b_1 = 3$$

$$c_1 = -8$$

So, considering $a_2 = 4$, $b_2 = 6$, $c_2 = 9$ will satisfy the condition for [parallel lines](#).

$$a_1/a_2 = 2/4 = 1/2$$

$$b_1/b_2 = 3/6 = 1/2$$

$$c_1/c_2 = -8/9$$

Thus, $a_1/a_2 = b_1/b_2 \neq c_1/c_2$ Therefore, another linear equation is $4x + 6y + 9 = 0$ **(iii) Coincident lines**Condition: $a_1/a_2 = b_1/b_2 = c_1/c_2$

$$2x + 3y - 8 = 0$$

Condition: $a_1/a_2 = b_1/b_2 \neq c_1/c_2$

$$2x + 3y - 8 = 0$$

We know that, $a_1 = 2$, $b_1 = 3$, $c_1 = -8$ So, considering $a_2 = 4$, $b_2 = 6$, $c_2 = -16$ will satisfy the condition for coincident lines.

$$a_1/a_2 = 2/4 = 1/2$$

$$b_1/b_2 = 3/6 = 1/2$$

$$c_1/c_2 = -8/(-16) = 1/2$$

Thus, $a_1/a_2 = b_1/b_2 = c_1/c_2$ Therefore, linear equation is $4x + 6y - 16 = 0$ **Question 7:**

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:

By plotting the graph of two [linear equations](#) and x-axis, a triangle can be formed and shaded and hence, the vertices can be located.

$$x - y + 1 = 0$$

$$\Rightarrow y = x + 1$$

x	-1	2
$y = x + 1$	0	3

$$3x + 2y - 12 = 0$$

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$$\Rightarrow 2y = 12 - 3x$$

$$\Rightarrow y = (12 - 3x) / 2$$

x	4	2
$y = (12 - 3x) / 2$	0	3

