CBSE Class–10 Mathematics

NCERT solution

Chapter - 3

Pair of Linear Equations in Two Variables - Exercise 3.2

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.

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

Ans. (i) Let number of boys who took part in the quiz = x

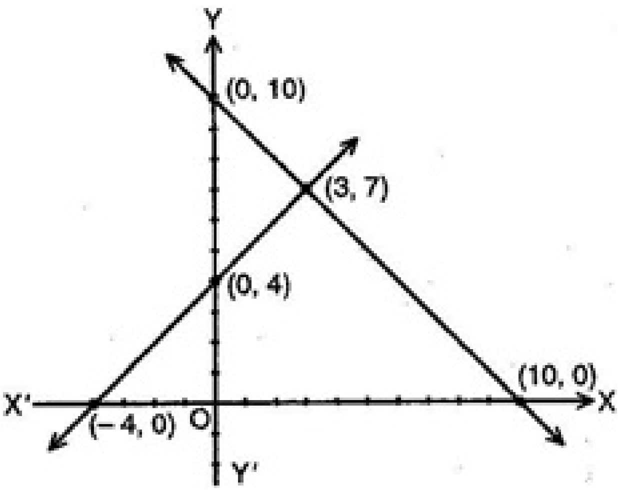
Let number of girls who took part in the quiz = y

According to given conditions, we have

$x + y = 10$... **(1)**

And, $y = x + 4$

$\Rightarrow x - y = -4$ ... **(2)**



For equation x + y = 10, we have following points which lie on the line

x	0	10
y	10	0

For equation x – y = –4, we have following points which lie on the line

x	0	– 4
y	4	0

We plot the points for both of the equations to find the solution.

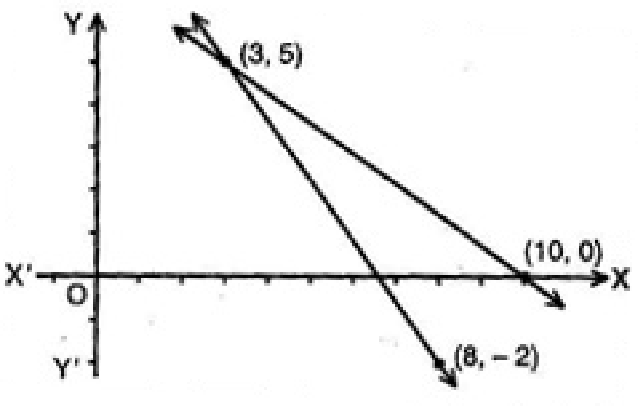
We can clearly see that the intersection point of two lines is **(3, 7).**

Therefore, number of boys who took park in the quiz = 3 and, number of girls who took part in the quiz = 7.

(ii) Let cost of one pencil = Rs x and Let cost of one pen = Rs y

According to given conditions, we have

$5x + 7y = 50$... **(1)**



$7x + 5y = 46$... **(2)**

For equation 5x + 7y = 50, we have following points which lie on the line

x	10	3
y	0	5

For equation 7x + 5y = 46, we have following points which lie on the line

x	8	3
y	−2	5

We can clearly see that the intersection point of two lines is **(3, 5).**

Therefore, cost of pencil = Rs 3 and, cost of pen = Rs 5

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2. On comparing the ratios $\frac{a_1}{a_2}, \frac{b_1}{b_2} and \frac{c_1}{c_2}$, find out whether the lines representing the following pairs of linear equations intersect at a point, are parallel or coincide:

(i) 5*x* − 4*y* + 8 = 0;   7x + 6y - 9 = 0

(ii)9*x* + 3*y* + 12 = 0; 18x + 6y + 24 = 0

(iii) 6*x* − 3*y* + 10 = 0; 2*x* – *y* + 9 = 0

Ans. (i) 5*x* − 4*y* + 8 = 0, 7*x* + 6*y* – 9 = 0

Comparing equation 5*x* − 4*y* + 8 = 0 with $a_1x+b_1y+c_1 = 0$ and 7*x* + 6*y* – 9 = 0 with $a_2x+b_2y+c_2 = 0$,

We get, $a_1 = 5$, $b_1 = -4$, $c_1 = 8$, $a_2 = 7$, $b_2 = 6$, $c_2 = -9$

We have $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ because $\frac{5}{7} \neq \frac{-4}{6}$

Hence, lines have unique solution which means they intersect at one point.

(ii) 9*x* + 3*y* + 12 = 0, 18*x* + 6*y* + 24 = 0

Comparing equation 9*x* + 3*y* + 12 = 0 with $a_1x+b_1y+c_1 = 0$ and 18*x* + 6*y* + 24 = 0 with $a_2x+b_2y+c_2 = 0$,

We get, $a_1 = 9$, $b_1 = 3$, $c_1 = 12$, $a_2 = 18$, $b_2 = 6$, $c_2 = 24$

We have $\frac{a_1}{a_2}=\frac{b_1}{b_2}=\frac{c_1}{c_2}$ because $\frac{9}{18}=\frac{3}{6}=\frac{12}{24} \Rightarrow \frac{1}{2}=\frac{1}{2}=\frac{1}{2}$

Hence, lines are coincide.

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

Comparing equation $6x-3y+10=0$ with $a_1x+b_1y+c_1=0$ and $2x-y+9=0$ with $a_2x+b_2y+c_2=0$,

We get, $a_1=6$, $b_1=-3$, $c_1=10$, $a_2=2$, $b_2=-1$, $c_2=9$

We have $\frac{a_1}{a_2}=\frac{b_1}{b_2}\neq\frac{c_1}{c_2}$ because $\frac{6}{2}=\frac{-3}{-1}\neq\frac{10}{9} \Rightarrow \frac{3}{1}=\frac{3}{1}\neq\frac{10}{9}$

Hence, lines are parallel to each other.

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3. On comparing the ratios $\frac{a_1}{a_2}, \frac{b_1}{b_2}$ and $\frac{c_1}{c_2}$, find out whether the following pair of linear equations are consistent, or inconsistent.

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

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

(iii) $\frac{3}{2}x+\frac{5}{3}y=7$, $9x-10y=14$

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

(v) $\frac{4}{3}x+2y=8; 2x+3y=12$

Ans. (i) $3x+2y=5$, $2x-3y=7$

Comparing equation $3x+2y=5$ with $a_1x+b_1y+c_1=0$ and $2x-3y=7$ with $a_2x+b_2y+c_2=0$,

We get, $a_1=3, b_1=2, c_1=-5$, $a_2=2, b_2=-3, c_2=-7$

$\frac{a_1}{a_2} = \frac{3}{2}$ and $\frac{b_1}{b_2} = \frac{2}{-3}$

Here $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ which means equations have unique solution.

Hence they are consistent.

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

Comparing equation $2x - 3y = 8$ with $a_1x + b_1y + c_1 = 0$ and $4x - 6y = 9$ with $a_2x + b_2y + c_2 = 0$,

We get, $a_1 = 2, b_1 = -3, c_1 = -8, a_2 = 4, b_2 = -6, c_2 = -9$

Here $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ because $\frac{2}{4} = \frac{-3}{-6} \neq \frac{-8}{-9} \Rightarrow \frac{1}{2} = \frac{1}{2} \neq \frac{-8}{-9}$

Therefore, equations have no solution because they are parallel.

Hence, they are inconsistent.

(iii) $\frac{3}{2}x + \frac{5}{3}y = 7$, $9x - 10y = 14$

Comparing equation $\frac{3}{2}x + \frac{5}{3}y = 7$ with $a_1x + b_1y + c_1 = 0$ and $9x - 10y = 14$ with $a_2x + b_2y + c_2 = 0$,

We get, $a_1 = \frac{3}{2}$, $b_1 = \frac{5}{3}$, $c_1 = -7, a_2 = 9, b_2 = -10, c_2 = -14$

$\frac{a_1}{a_2} = \frac{\frac{3}{2}}{9} = \frac{1}{6}$ and $\frac{b_1}{b_2} = \frac{\frac{5}{3}}{-10} = \frac{-1}{6}$

Here $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

Therefore, equations have unique solution.

Hence, they are consistent.

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

Comparing equation $5x - 3y = 11$ with $a_1x + b_1y + c_1 = 0$ and $-10x + 6y = -22$ with $a_2x + b_2y + c_2 = 0$,

We get, $a_1 = 5, b_1 = -3, c_1 = -11, a_2 = -10, b_2 = 6, c_2 = 22$

$\frac{a_1}{a_2} = \frac{5}{-10} = \frac{-1}{2}, \frac{b_1}{b_2} = \frac{-3}{6} = \frac{-1}{2}$ and $\frac{c_1}{c_2} = \frac{-11}{22} = \frac{-1}{2}$

Here $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Therefore, the lines have infinite many solutions.

Hence, they are consistent.

(v) $\frac{4}{3}x + 2y = 8; \;\; 2x + 3y = 12$

Comparing equation $\frac{4}{3}x + 2y = 8$ with $a_1x + b_1y + c_1 = 0$ and $2x + 3y = 12$ with $a_2x + b_2y + c_2 = 0$,

We get, $a_1 = \frac{4}{3}, b_1 = 2, c_1 = -8, a_2 = 2, b_2 = 3, c_2 = -12$

$\frac{a_1}{a_2} = \frac{\frac{4}{3}}{2} = \frac{2}{3}, \frac{b_1}{b_2} = \frac{2}{3}$ and $\frac{c_1}{c_2} = \frac{8}{12} = \frac{2}{3}$

Here $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

Therefore, the lines have infinite many solutions.

Hence, they are consistent.

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

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

For equation x + y = 5 we have following points which lie on the line

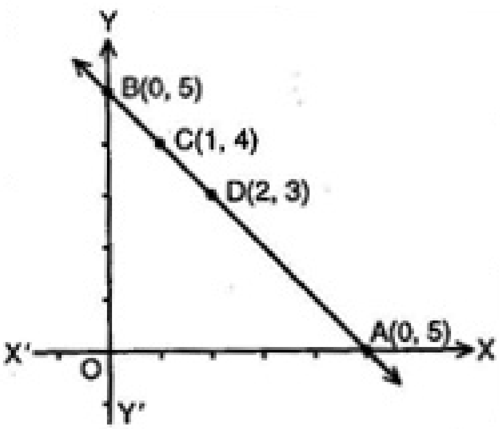
x	0	5
y	5	0

For equation 2x + 2y – 10 = 0, we have following points which lie on the line

x	1	2
y	4	3

We can see that both of the lines coincide. Hence, there are infinite many solutions. Any point which lies on one line also lies on the other. Hence, by using equation ($x + y - 5 = 0$), we can say that $x = 5 - y$

We can assume any random values for y and can find the corresponding value of x using the above equation. All such points will lie on both lines and there will be infinite number of such points.



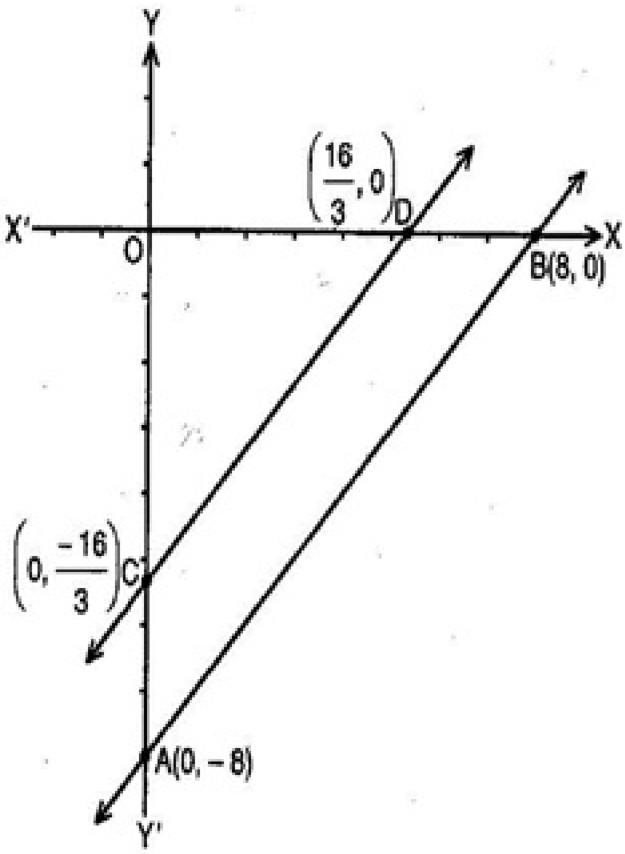
(ii) $x - y = 8$, $3x - 3y = 16$

For x – y = 8, the coordinates are:

x	0	8
y	– 8	0

And for 3x – 3y = 16, the coordinates

x	0	$\frac{16}{3}$
y	$\frac{-16}{3}$	0



Plotting these points on the graph, it is clear that both lines are parallel. So the two lines have no common point. Hence the given equations have no solution and lines are inconsistent.

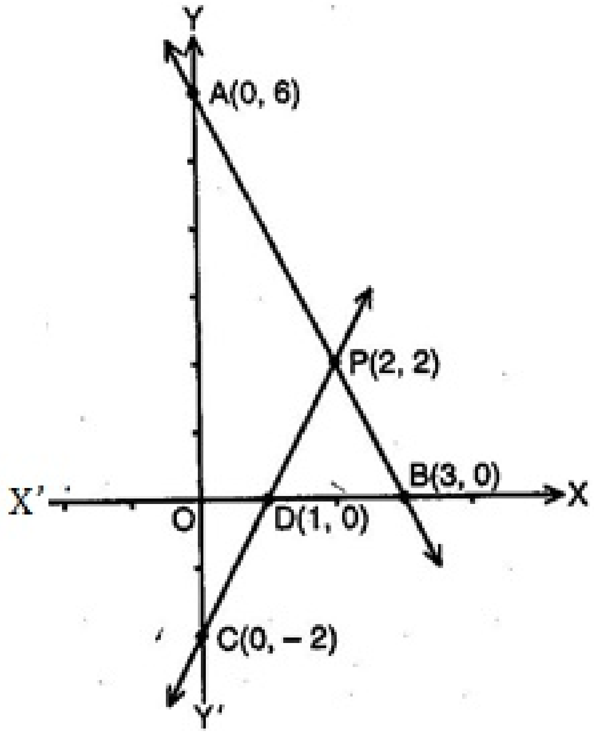
(iii) $2x + y - 6 = 0$, $4x - 2y - 4 = 0$

For equation 2x + y – 6 = 0, we have following points which lie on the line

x	0	3
y	6	0

For equation 4x – 2y – 4 = 0, we have following points which lie on the line

x	0	1
y	−2	0



We can clearly see that lines are intersecting at (2, 2) which is the solution.

Hence x = 2 and y = 2 and lines are consistent.

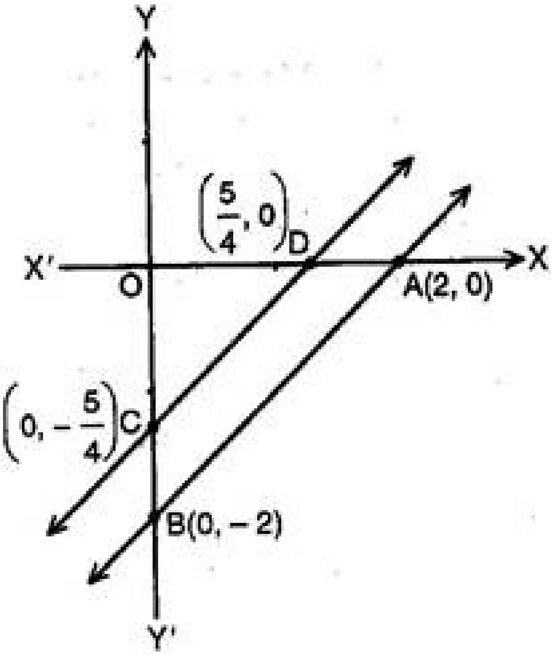
(iv) $2x - 2y - 2 = 0$, $4x - 4y - 5 = 0$

For 2x – 2y – 2 = 0, the coordinates are:

x	2	0
y	0	−2

And for 4x – 4y – 5 = 0, the coordinates

x	0	$\frac{5}{4}$
y	$\frac{-5}{4}$	0



Plotting these points on the graph, it is clear that both lines are parallel. So the two lines have no common point. Hence the given equations have no solution and lines are inconsistent.

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

Ans. Let length of rectangular garden = x metres

Let width of rectangular garden = y metres

According to given conditions, perimeter = 36 m

$\Rightarrow \frac{1}{2}\left[2\left(x+y\right)\right]=36$

$\Rightarrow$ x + y = 36 ……(i)

And x = y + 4

$\Rightarrow x - y = 4$........(ii)

Adding eq. (i) and (ii),

2x = 40

$\Rightarrow$ x = 20 m

Subtracting eq. (ii) from eq. (i),

2y = 32

$\Rightarrow$ y = 16 m

Hence, length = 20 m and width = 16 m

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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

Ans. (i) Let the second line be equal to $a_2x + b_2y + c_2 = 0$

Comparing given line **2x** + **3y** – **8** = **0** with $a_1x + b_1y + c_1 = 0$,

We get $a_1 = 2, b_1 = 3 \; and \; c_1 = -8$

Two lines intersect with each other if $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

So, second equation can be **x** + **2y** = **3** because $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$

(ii) Let the second line be equal to $a_2x + b_2y + c_2 = 0$

Comparing given line **2x** + **3y** – **8** = **0** **with** $a_1x + b_1y + c_1 = 0$,

We get $a_1 = 2, b_1 = 3 \, and \, c_1 = -8$

Two lines are parallel to each other if $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

So, second equation can be **2x** + **3y** – **2** = **0** because $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

(iii) Let the second line be equal to $a_2x + b_2y + c_2 = 0$

Comparing given line **2x** + **3y** – **8** = **0** **with** $a_1x + b_1y + c_1 = 0$,

We get $a_1 = 2, b_1 = 3 \, and \, c_1 = -8$

Two lines are coincident if $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

So, second equation can be **4x** + **6y** – **16** = **0** because $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

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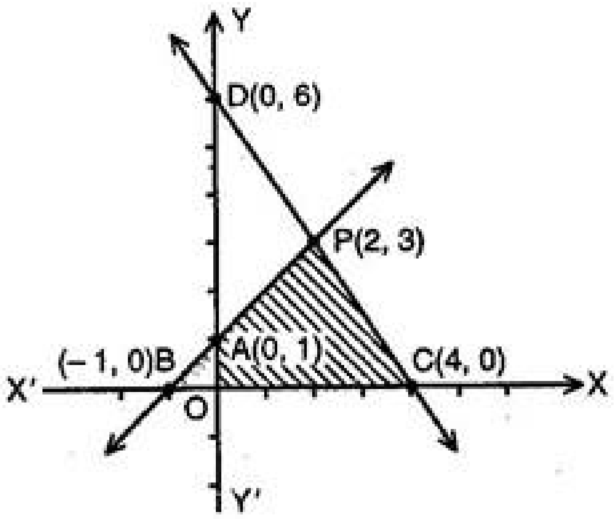
7. Draw the graphs of the equations x – y + 1 = 0 and 3x + 2y – 12 = 0. Determine the coordinates of the vertices of the triangle formed by these lines and the x-axis, and shade the triangular region.

Ans. For equation x – y + 1 = 0, we have following points which lie on the line

x	0	–1
y	1	0

For equation 3x + 2y – 12 = 0, we have following points which lie on the line

x	4	0
y	0	6



We can see from the graphs that points of intersection of the lines with the x–axis are (–1, 0), (2, 3) and (4, 0).