CBSE Test Paper 05

Chapter 3 Pair of Linear Equation

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1. The area of the triangle formed by 2x – y + 6 = 0, 4x + 5y – 16 = 0 and the x – axis is **(1)**
   a. 15 sq. units
   b. 16 sq. units
   c. 14 sq. units
   d. 12 sq. units
2. The system of equations 2x + 3y - 7 = 0 and 6x + 5y - 11 = 0 has **(1)**
   a. unique solution
   b. infinite many solutions
   c. no solution
   d. non zero solution
3. The pair of linear equations 5x – 3y = 11 and – 10x + 6y = – 22 are **(1)**
   a. dependent(consistent)
   b. None of these
   c. consistent
   d. inconsistent
4. The system of linear equations $a_1x + b_1y_1 + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ has no solution if **(1)**
   a. $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$
   b. $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$
   c. $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$
   d. None of these
5. Ten students of class X took part in Mathematics quiz. The number of girls is 4 more than that of the boys. The algebraic representation of the above situation is **(1)**
   a. none of these

b. x – y = 10 and x + y = 4
c. x = y - 12 and y = 6 + x
d. y = x + 4 and x = 10 - y

6. Given the linear equation 3x + 4y - 8 = 0, write another linear equation in two variables such that the geometrical representation of the pair so formed is parallel lines. **(1)**

7. Write whether the following pair of linear equations is consistent or not. **(1)**
   x + y = 14
   x - y = 4

8. In a deer park, the number of heads and the number of legs of deer and human visitors were counted and it was found that there were 39 heads and 132 legs. Find the number of deer and human visitors in the park. **(1)**

9. Write the value of k for which the system of equations x + y - 4 =0 and 2x + ky - 3 =0 has no solution. **(1)**

10. Determine k for which the system of equations has infinite solutions: **(1)**
    4x + y = 3 and 8x + 2y = 5k

11. Solve the following system of equations: **(2)**
    $2x - \frac{3}{y} = 9$
    $3x + \frac{7}{y} = 2, y \neq 0$

12. Determine the values of a and b for which the following system of linear equations has infinite solutions: **(2)**
    2x - (a - 4)y = 2b + 1
    4x - (a - 1)y = 5b - 1

13. Solve the following system of linear equation by substitution method: **(2)**
    2x - y = 2 ...(i)
    x + 3y = 15 ....(ii)

14. Solve for x and y: $\frac{3}{x+y} + \frac{2}{x-y} = 2; \frac{9}{x+y} - \frac{4}{x-y} = 1.$ **(3)**

15. Draw the graphs of the equations 4x - y - 8 = 0 and 2x - 3y + 6 = 0. Also, determine the vertices of the triangle formed by the lines and x-axis. **(3)**

16. Solve the following pairs of equations by reducing them to a pair of linear equations: **(3)**
    $\frac{1}{(3x+y)} + \frac{1}{(3x-y)} = \frac{3}{4}$ and $\frac{1}{2(3x+y)} - \frac{1}{2(3x-y)} = \frac{-1}{8}$

17. 2 men and 5 boys can finish a piece of work in 4 days, while 3 men and 6 boys can finish it in 3 days. Find the time taken by one man alone to finish the work and that taken by one boy alone to finish the work. **(3)**

18. A motor boat takes 6 hours to cover 100 km downstream and 30 km upstream. If the boat goes 75 km downstream and returns back to the starting point in 8 hours. Find the speed of the boat in still water and the speed of the stream. **(4)**

19. Solve the following system of linear equation graphically
    4x-5y-20=0 and 3x+5y-15=0.
    Also, find the coordinates of the vertices of the Triangle formed by these two lines and the Y-axis. **(4)**

20. Solve the following system of linear equations graphically and shade the region between the two lines and x-axis: **(4)**
    3x + 2y - 4 = 0,
    2x - 3y - 7 = 0

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Solution

1. c. 14 sq. units

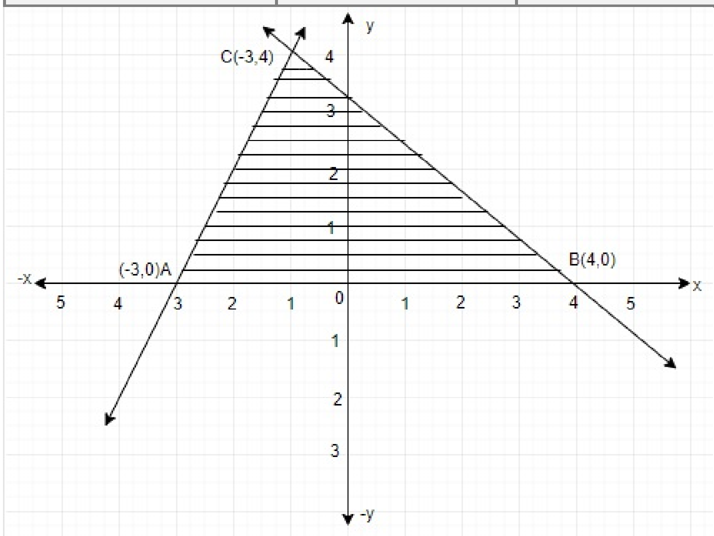
   Explanation: Here are the two solutions of each of the given equations.

   $2x - y + 6 = 0,$

x	0	-1	-2
y	6	1	2

   $4x + 5y - 16 = 0$

x	4	1.5	-1
y	0	2	4



   The triangle ABC formed by given two linear equations is shaded in the graph.

   $\therefore$ Area of triangle ABC = $\frac{1}{2} \times$ Base $\times$ Height = $\frac{1}{2} \times 7 \times 4$ = 14 sq. units

2. a. unique solution

   Explanation: 2x + 3y - 7 = 0

   6x + 5y - 11 = 0

   By Comparing with $a_1x + b_1y + c = 0$ and $a_2x + b_2y + c = 0$,

   Here, $a_1 = 2$, $b_1 = 3$, $c_1 = -7$, and $a_2 = 6$, $b_2 = 5$, $c_2 = -11$

   $\frac{a_1}{a_2} = \frac{2}{6} = \frac{1}{3}$

   $\frac{b_1}{b_2} = \frac{3}{5}$

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

Therefore, system of equations has unique solution.

3. a. dependent(consistent)

Explanation: Given: a_1 = 5, a_2 = -10, b_1 = -3, b_2 = 6, c_1 = 11 and c_2 =-22

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

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

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

Therefore, the pair of given linear equations is consistent.

4. a. $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

Explanation: The system of linear equations $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$ has no solution because both the equation satisfy the condition i.e

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

5. d. y = x + 4 and x = 10 - y

Explanation: Let the number of boys = x

Number of girls = y

Given, that total number of student is 10. So that

x + y = 10

Subtracting y on both sides, we get

x = 10 – y

Given, that If the number of girls is 4 more than the number of boys

So that, y = x + 4

6. Given equation 3x + 4y - 8 = 0

Lines are parallel when $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

$\therefore$ One of the linear equation in two variables can be 6x + 8y + k = 0 where k is constant not equal to -16.

7. Given,x + y = 14 and x - y = 4 such that a_1=1, b_1=1, c_1=-14 and a_2=1,b_2=-1, c_2=-4

Now, $\frac{a_1}{a_2}$ = 1 and $\frac{b_1}{b_2}$ = -1

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

$\Rightarrow$ The equations have unique solution.

Therefore pair of linear equations is consistent.

8. Let a number of humans be x and deer be y.

   then, $x + y = 39$ ....(i)

   and $2x + 4y = 132$

   $x + 2y = 66$ .....(ii)

   On solving (i) and (ii), we get

   $-y = -27$

   $\Rightarrow$ y = 27, x = 12

9. Given system of equations x + y - 4 =0 and 2x + ky - 3 =0. With a_1=1, b_1=1, c_1=-4 and a_2=2, b_2=k, c_2=-3

   For no solution $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$

   $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$
   then, $\frac{1}{2} = \frac{1}{k} = \frac{-4}{-3}$ ...... (1)
   then $\frac{1}{2} = \frac{1}{k}$
   $\Rightarrow$ k=2
   Substitute k=2 in (1) we get $\frac{1}{k} = \frac{1}{2} \neq \frac{4}{3}$
   Hence, $k \neq \frac{3}{4}$ for no solution

10. For infinite many solutions
    $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$
    $\frac{4}{8}$ = $\frac{1}{2}$ = $\frac{-3}{-5k}$ $\Rightarrow$ $\frac{1}{2}$ = $\frac{3}{5k}$
    5k = 6 $\Rightarrow$ k = $\frac{6}{5}$

11. The given system of equations is
    $2x - \frac{3}{y} = 9$ .... (i)
    $3x + \frac{7}{y} = 2, y \neq 0$ .... (ii)
    Taking $\frac{1}{y} = u$, the given equations become,

    2x - 3u = 9 .... (iii)

    3x + 7u = 2 .... (iv)

    From (iii), we get 2x = 9 + 3u

$\Rightarrow x=\frac{9+3u}{2}$

Substituting $x=\frac{9+3u}{2}$ in (iv), we get

$3\left(\frac{9+3u}{2}\right)+7u=2$

$\Rightarrow \frac{27+9u+14u}{2}=2$

$\Rightarrow 27+23u=2\times 2$

$\Rightarrow 23u=4-27$

$\Rightarrow u=\frac{-23}{23}=-1$

Hence, $y=\frac{1}{u}=\frac{1}{-1}=-1$

Putting $u=-1$ in $x=\frac{9+3u}{2}$, we get

$x=\frac{9+3(-1)}{2}=\frac{9-3}{2}=\frac{6}{2}=3$

$\Rightarrow x=3$

Hence, Solution of the given system of equation is x = 3, y = -1.

12. 2x - (a - 4)y = 2b + 1 .... (i)

4x - (a - 1)y = 5b - 1 .... (ii)

Compare the equations with form of equations

$a_1x + b_1y = c_1$

$a_2x + b_2y = c_2$

We get, $a_1 = 2$, $b_1 = -(a - 4)$ and $c_1 = (2b + 1)$

$a_2 = 4$, $b_2 = -(a - 1)$ and $c_2 = (5b - 1)$

Equations has infinite number of solutions, if

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

Therefore, the given system of equations will have infinite number of solutions, if

$\frac{2}{4}=\frac{-(a-4)}{-(a-1)}=\frac{2b+1}{5b-1}$

$\Rightarrow \quad \frac{1}{2}=\frac{a-4}{a-1}=\frac{2b+1}{5b-1}$

$\Rightarrow \quad \frac{1}{2}=\frac{a-4}{a-1}$ and $\frac{1}{2}=\frac{2b+1}{5b-1}$

$\Rightarrow$ a - 1= 2a - 8 and 5b -1 = 4b + 2

$\Rightarrow$ a = 7 and b = 3

13. Given, 2 x -y = 2 ..(i)

x + 3y = 15 ..(ii)

From eqn. (i), we get y = 2x - 2 ... (iii)

Substituting the value of y in eqn. (ii),

x + 3y = 15

x + 3(2x - 2) = 15

x + 6x - 6 = 15

7x = 15 + 6

or, 7x = 21

∴ x = 3

Substituting this value of x in (iii), we get

y = 2x - 2

y = 2 $\times$ 3 - 2

y = 6 - 2

y = 4

Hence the value of x and y of given equations are 3 and 4 respectively.

14. According to the question,

$\frac{3}{x+y}+\frac{2}{x-y}=2$
$\frac{9}{x+y}-\frac{4}{x-y}=1$
Putting $\frac{1}{x+y}$ =u and $\frac{1}{x-y}$ = v ,

$3u+2v=2$ .... (i)

$9u-4v=1$ .... (ii)

Multiplying (i) by 2 and (ii) by 1,

$\Rightarrow 6u+4v=4$ .... (iii)

$9u-4v=1$ .... (iv)

Adding (iii) and (iv),

$\Rightarrow 15u=5, u=\frac{5}{15}=\frac{1}{3}$

Putting u = $\frac{1}{3}$ in (i),

$\Rightarrow 3\times\frac{1}{3}+2v=2\Rightarrow 1+2v=2\Rightarrow 2v=1$

$v=\frac{1}{2}$

Now, $u=\frac{1}{3}\Rightarrow\frac{1}{x+y}=\frac{1}{3}\Rightarrow x+y=3$..........(v)

and $v=\frac{1}{2}\Rightarrow\frac{1}{x-y}=\frac{1}{2}\Rightarrow x-y=2$.............(vi)

Adding (v) and (vi),

$\Rightarrow 2x=5\Rightarrow x=\frac{5}{2}$

Putting $x=\frac{5}{2}$ in (v),

$\Rightarrow \frac{5}{2}+y=3 \Rightarrow y=3-\frac{5}{2}=\frac{6-5}{2}=\frac{1}{2}$.

The solution is $x=\frac{5}{2}, y=\frac{1}{2}$

15. $4x-y-8=0$ or $-y=-4x+8$,

$\Rightarrow y=4x-8$,

Solution table for $4x-y-8=0$ is

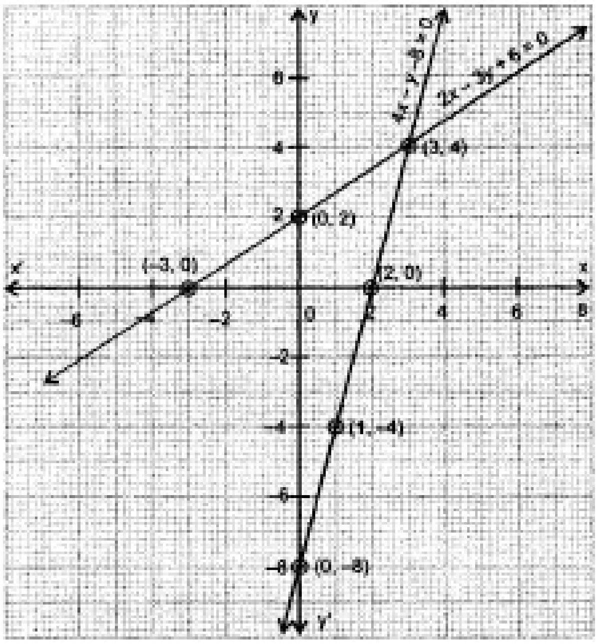
x	0	1	2
y	-8	-4	0

$2x-3y+6=0;\ -3y=-2x-6$

$3y=2x+6$

Solution table for $2x-3y+6=0$ is

x	0	3	-3
y	2	4	0



Vertices of the triangle formed by lines and x-axis are $(2,0),(3,4)\ and\ (-3,0)$.

16. The given pair of the equation is:

$\frac{1}{(3x+y)}+\frac{1}{(3x-y)}=\frac{3}{4}$ .... (1)

$\frac{1}{2(3x+y)}-\frac{1}{2(3x-y)}=\frac{-1}{8}$ .... (2)

Put, $\frac{1}{3x+y}=u$ .... (3)
and $\frac{1}{3x-y}=v$ .... (4)
Then, the equation (1) and (2) can be rewritten as :
$u+v=\frac{3}{4}$ ....(5)
$\frac{1}{2}u-\frac{1}{2}v=-\frac{1}{8}$ ....(6)

Equation(6) gives
$u-v=-\frac{1}{4}$ ....(7)......Multiplying both sides by 2
Adding equation(5) to equation (7), we get
$2u=\frac{3}{4}-\frac{1}{4}=\frac{1}{2}\Rightarrow u=\frac{1}{4}$ .... (8)

Subtracting equation(7) from equation (5), we get $2v=\frac{3}{4}+\frac{1}{4}=1$
$\Rightarrow \quad v=\frac{1}{2}$ .... (9)
From equation(3) and equation(8), we get $\frac{1}{3x+y}=\frac{1}{4}$
$\Rightarrow 3x\ +\ y=4$ .... (10)
From equation (4) and equation (9), we get
$\frac{1}{3x-y}=\frac{1}{2}\Rightarrow 3x-y=2$................(11)
Adding equation (10) and equation(11), we get 6x = 6
$\Rightarrow x=\frac{6}{6}=1$
Substitute this value of x in equation (1), we get 3(1) + y =4
$\Rightarrow 3\ +\ y=4$
$\Rightarrow y\ =\ 4\ -\ 3\ =\ 1$
Hence, the solution of the given pair of equation is x = 1, y =1
Verification, Substituting x =1, y =1.
We find that both the equations (1) and (2) are satisfied as shown below:
$\frac{1}{3x+y}+\frac{1}{3x-y}=\frac{1}{3(1)+1}+\frac{1}{3(1)-1}=\frac{1}{4}+\frac{1}{2}=\frac{3}{4}$
$\frac{1}{2(3x+y)}-\frac{1}{2(3x-y)}-\frac{1}{2(3.1+1)}-\frac{1}{2(3.1-1)}$
$=\frac{1}{8}-\frac{1}{4}=-\frac{1}{8}$.
This verifies the solution.

17. Suppose man's 1 day's work be $\frac{1}{x}$ and boy's 1 day's work be $\frac{1}{y}$
Suppose, $\frac{1}{x}$ = u and $\frac{1}{y}$ = v
By first condition,

$\frac{2}{x}+\frac{5}{y}=\frac{1}{4}\Rightarrow 2u+5v=\frac{1}{4}$ .... (i)

By second condition,

$\frac{3}{x}+\frac{6}{y}=\frac{1}{3}\Rightarrow 3u+6v=\frac{1}{3}$ .... (ii)

Multiplying (i) by 6 and (ii) by 5,

$\Rightarrow 12u+30v=\frac{6}{4}$ ....(iii)

$15u+30v=\frac{5}{3}$ ....(iv)

Subtracting (iii) and (iv),

$\Rightarrow 3u=\frac{5}{3}-\frac{6}{4}$

$\Rightarrow 3u=\frac{20-18}{12}$

$\Rightarrow 3u=\frac{2}{12}$

$\Rightarrow 3u=\frac{1}{6}$

$\Rightarrow u=\frac{1}{18}$

Putting u = $\frac{1}{18}$ in (i),

$\Rightarrow 2\times\frac{1}{18}+5v=\frac{1}{4}\Rightarrow\frac{1}{9}+5v=\frac{1}{4}\Rightarrow 5v=\frac{1}{4}-\frac{1}{9}$

$\Rightarrow 5v=\frac{5}{36}\Rightarrow v=\frac{1}{36}$

Now, $u=\frac{1}{18}\Rightarrow x=\frac{1}{4}=18$

and $v=\frac{1}{36}\Rightarrow y=\frac{1}{v}=36$

$\therefore x=18, y=26$

The man will complete the given work in 18 days and the boy will complete the given work in 36 days when they work alone.

18. Let the speed of the motor boat in still water be x km / hour and the speed of he stream by y km/hour. Then,

The speed of the motor boat downstream = (x + y) km / hour

And, the speed of the motor boat upstrram = (x - y) km / hour

Also, $\text{time}=\frac{\text{distance}}{\text{Speed}}$

In the first case, the motor boat takes 6 hour to cover 100 km downstream and 30 km upstream.

$\therefore\ \frac{100}{x+y}+\frac{30}{x-y}=6$ ...(1)

In the second case, the motor boat goes 75 km downstream and returns back to the starting point in 8 hours.

$\therefore\ \frac{75}{x+y}+\frac{75}{x-y}=8$ ...(2)

Put $\frac{1}{x+y}=u$ ...(3)

And $\frac{1}{x-y}=v$ ...(4)

Then equation (1) and (2) can be rewritten as

100u + 30v = 6 ...(5)

75u + 75u = 8 ...(6)

From equation (5)

50u + 15v = 3 ...(7) ... Dividing by 2

Multiplying equation (7) by 5, we get

250u + 75v = 15 ...(8)

Subtracting equation (6) from equation (8), we get 175u = 7

$\Rightarrow u=\frac{7}{175}=\frac{1}{25}$ ...(9)

Substituting this values of u in equation (7), we get $50\left(\frac{1}{25}\right)+15v=3$

⇒ 2+ 15v = 3 ⇒ 15v = 1

$\Rightarrow\ v=\frac{1}{15}$ ...(10)

from equation (3) and equation (9), we get $\frac{1}{x+y}=\frac{1}{25}$

⇒ x + y = 25 ...(11)

From equation (4) adn equation (10), we get $\frac{1}{x-y}=\frac{1}{15}$

⇒ x - y = 15 ...(12)

Adding equation (11) and equation (12), we get 2x = 40

$\Rightarrow\ x=\frac{40}{2}=20$

substituting this value of x in equation (11), we get 20 + y = 25

⇒ y = 5

Hence, the speed of the boat in still water is 20 km/hour and the speed of the stream is 5 km/hour.

Verification : Substituting x = 20 and y = 5, We fin that both the equations (1) and (2) are satisfied as shown below:

$\frac{100}{x+y}+\frac{30}{x-y}=\frac{100}{20+5}+\frac{30}{20-5}$ = 4 + 2 = 6

$\frac{75}{x+y}+\frac{75}{x-y}=\frac{75}{20+5}+\frac{75}{20-5}$ = 3 + 5 = 8

19. Given equations, 4x-5y-20=0 and 3x+5y-15=0.

Now,4x-5y-20=0

When y=0, then x=5

When y=-4, then x=0

Thus, we have the following table:

x	5	0
y	0	-4

Now, 3x+5y-15=0

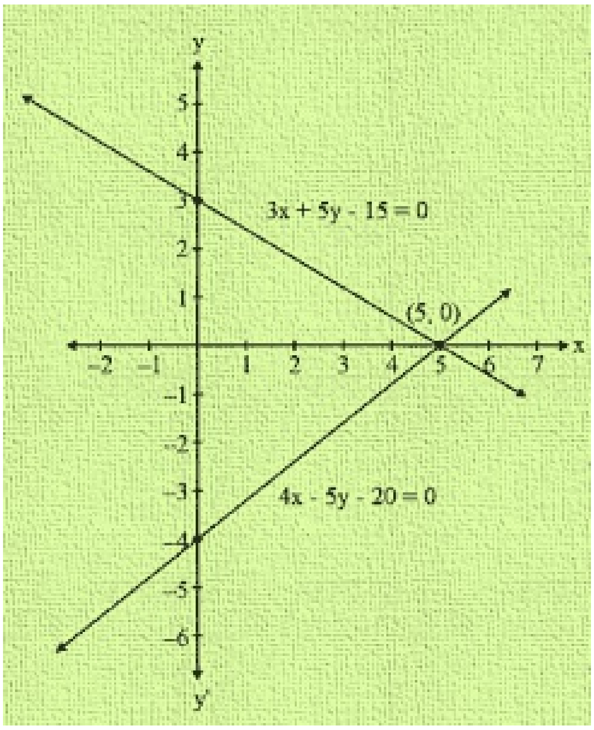
When y=0, then x=5

When y=3, then x=0

Thus, we have the following table:

x	5	0
y	0	3

Graph of the given system of equations:



Clearly, the two lines intersect at A(5,0).

Hence x=5 , y=0 is the solution of the given system of equations.

The lines meet y-axis at B(0,-4) and C(0,3) respectively.

Therefore, The vertices of the triangle are (5,0) , (0,-4) and (0,3)

20. Given system of linear equations is

3x + 2y - 4 = 0.....(1)

2x - 3y - 7 = 0.....(2)

Now for equation 3x + 2y - 4 = 0

$x = \frac{4-2y}{3}$

When y = 5, then x = -2

When y = 8, then x = -4

Thus, we have the following table:

x	-2	-4
y	5	8

We have,

2x - 3y - 7 = 0

$x = \frac{3y+7}{2}$

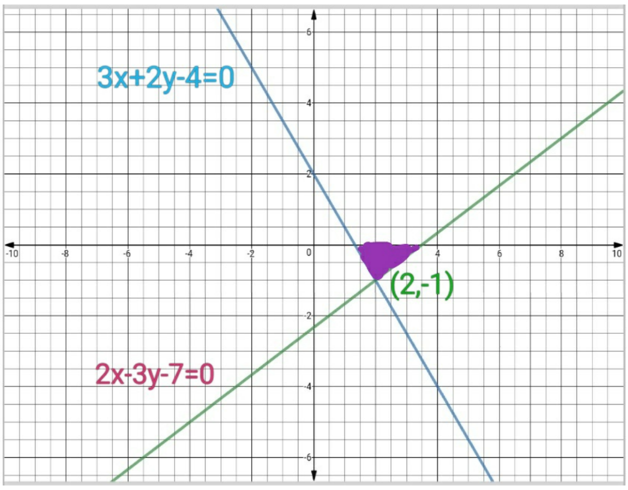
When y = 1, then x = 5

When y = -1, then x = 2

Thus, we have the following table:

x	2	5
y	-1	1

Graph of the given system is:



Clearly, the two lines intersect at (2, -1). Also, area between the given system of linear equations and x-axis is shaded.

Hence x = 2 and y = -1 is the solution of the given system of equations.