Chapter :-3

Pair of Linear equation in two variables

Ex :- 3.1

Q1 Aftab tells his daughter, "Seven years ago, I was seven times as old as you were then. Also, three years from now, I shall be three times as old as you will be." (Isn't this interesting)? Represent this situation algebraically and graphically.

Sol Let Present age of aftab = x years
" " " daughter = y years

Seven years ago age of aftab = $(x-7)$ years
Age of daughter = $(y-7)$ years

A.T.Q :- $(x-7) = 7(y-7)$

$x-7 = 7y-49$

$x-7y = -49+7$

$\boxed{x-7y = -42}$ OR $\boxed{x-7y+42=0}$

After three years age of Aftab = $(x+3)$ years
Age of daughter = $(y+3)$ years

$(x+3) = 3(y+3)$

$x+3 = 3y+9$

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$$x - 3y = 9 - 3$$

$$\boxed{x - 3y = 6} \text{ OR } \boxed{x - 3y - 6 = 0}$$

Graphical Representation :- Put $x = 0$

$$x - 7y = -42$$
$$-7y = -42 - x$$
$$y = \frac{42 + x}{7}$$

$$y = \frac{42 + 0}{7} = \frac{42}{7} = 6$$

Put $x = 7$

$$\frac{42 + 7}{7} = \frac{49}{7} = 7$$

x	0	7
y	6	7

$$x - 3y = 6$$
$$-3y = 6 - x$$
$$3y = -6 + x$$
$$3y = x - 6$$
$$y = \frac{x - 6}{3}$$

Put $x = 0$

$$y = \frac{0 - 6}{3} = \frac{-6}{3} = -2$$

Put $x = 3$

$$y = \frac{3 - 6}{3} = \frac{-3}{3} = -1$$

x	0	3
y	-2	-1

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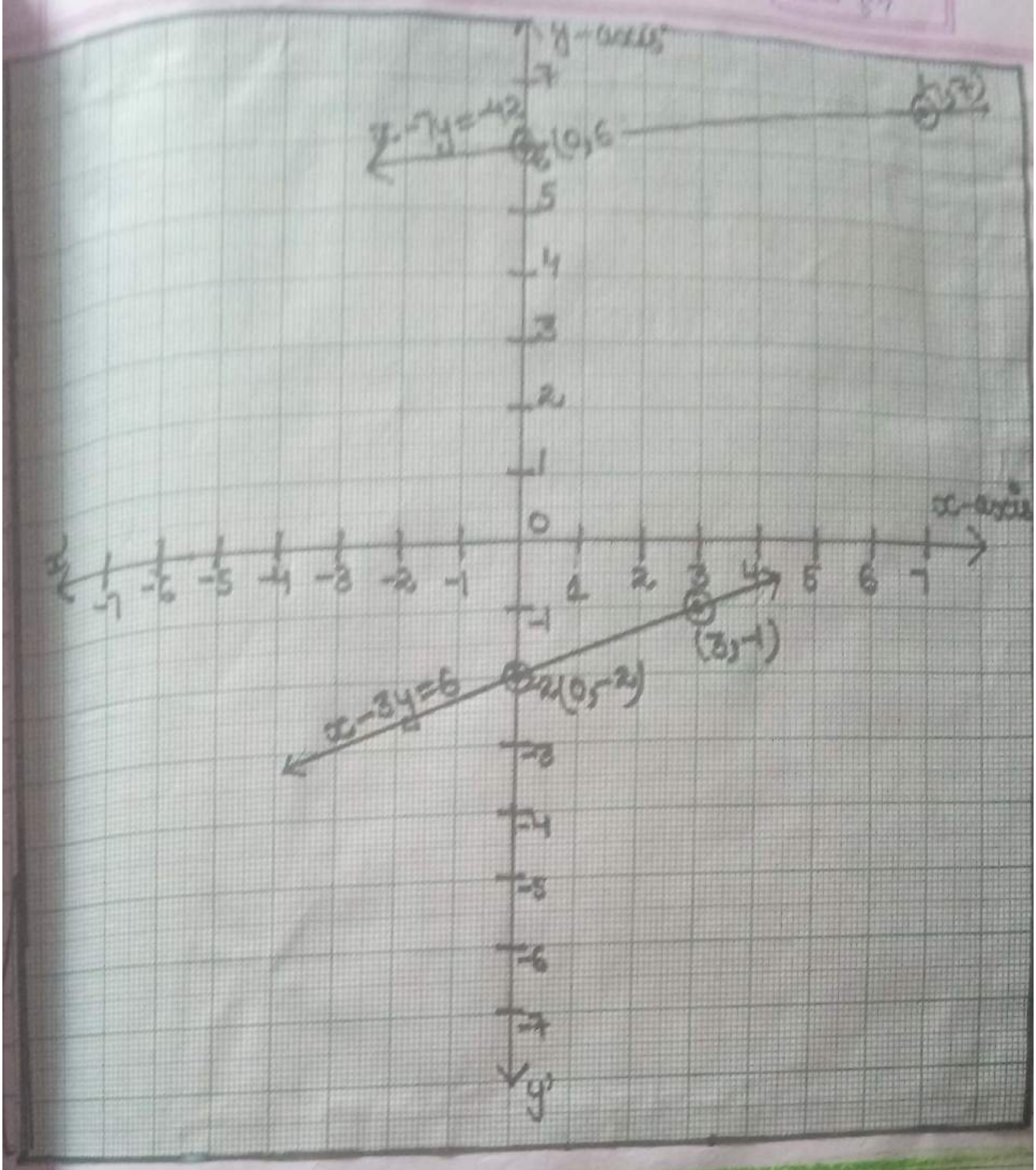

Ques 13: The coach of cricket team buys 3 bats and 6 balls for Rs. 3900. Later, she buys another bat and 3 more balls of the same kind for Rs. 1300. Represent this situation algebraically and geometrically.

Sol: Cost of 1 bat = Rs. x

Cost of 1 ball = Rs. y

$3x + 6y = 3900$ (divide by 3)

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$\frac{2x}{2} + \frac{2y}{2} = \frac{2600}{2}$ $1300 = 1300$

$x + 2y = 1300$ and $x + 3y = 1300$

$2y = 1300 - x$

$y = \frac{1300 - x}{2}$

Put $x = 100$

$y = \frac{1300 - 100}{2}$

$y = \frac{1200}{2}$ $600 = 600$

Put $x = 300$

$y = \frac{1300 - 300}{2}$

$y = \frac{1000}{2}$ 500

$y = 500$

x	100	300
y	600	500

$x + 3y = 1300$

$3y = 1300 - x$

$y = \frac{1300 - x}{3}$

Put $x = 100$

$y = \frac{1300 - 100}{3}$

$y = \frac{1200}{3}$ 400

Put $x = 400$

$y = \frac{1300 - 400}{3}$

$y = \frac{900}{3}$ 300

x	100	400
y	400	300

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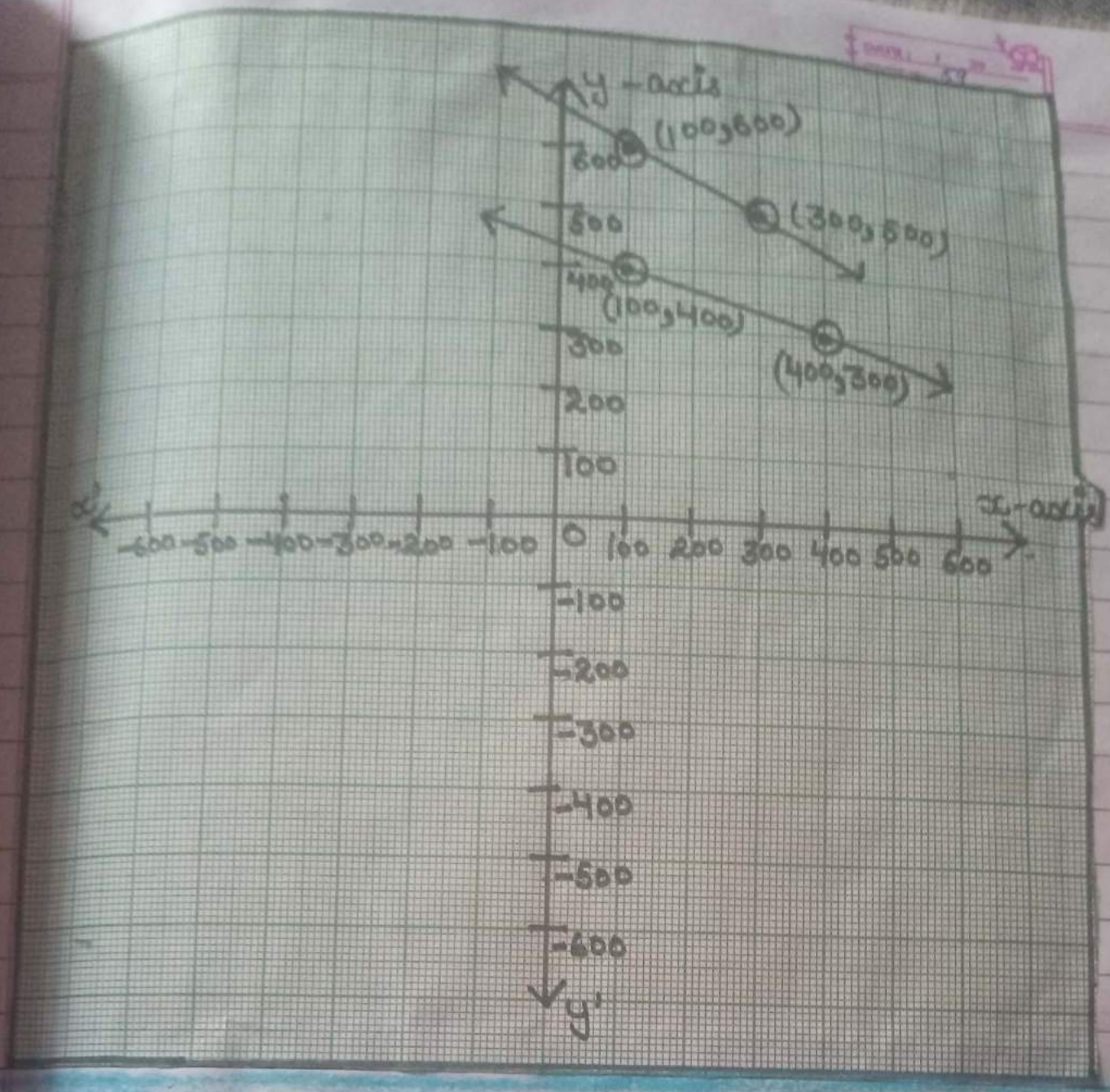

Q(13) The cost of 2kg of apples and 1kg of grapes on a day was found to be Rs. 160. After a month, the cost of 4kg Apples and 2kg of grapes is Rs. 300. Represent this situation algebrically and geometrically.

Sol: Let cost of 2kg apples = Rs. x

cost of 1kg grapes = Rs. y

$$2x + y = 160$$

$$4x + 3y = 300$$

$$2x + y = 160$$

$$y = 160 - 2x$$

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Put $x = 50$

$y = 160 - 2 \times 50$

$y = 160 - 100$

$y = 60$

Put $x = 40$

$y = 160 - 2 \times 40$

$y = 160 - 80$

$y = 80$

x	50	40
y	60	80

$4x + 2y = 300$

$2y = 300 - 4x$

$y = \frac{300 - 4x}{2}$

Put $x = 50$

$y = \frac{300 - 4 \times 50}{2}$

$y = \frac{300 - 200}{2}$

$y = \frac{100}{2}^{50}$

$y = 50$

Put $x = 60$

$y = \frac{300 - 4 \times 60}{2}$

$y = \frac{300 - 240}{2}$

$y = \frac{60}{2}^{30}$

$y = 30$

x	50	60
y	50	30

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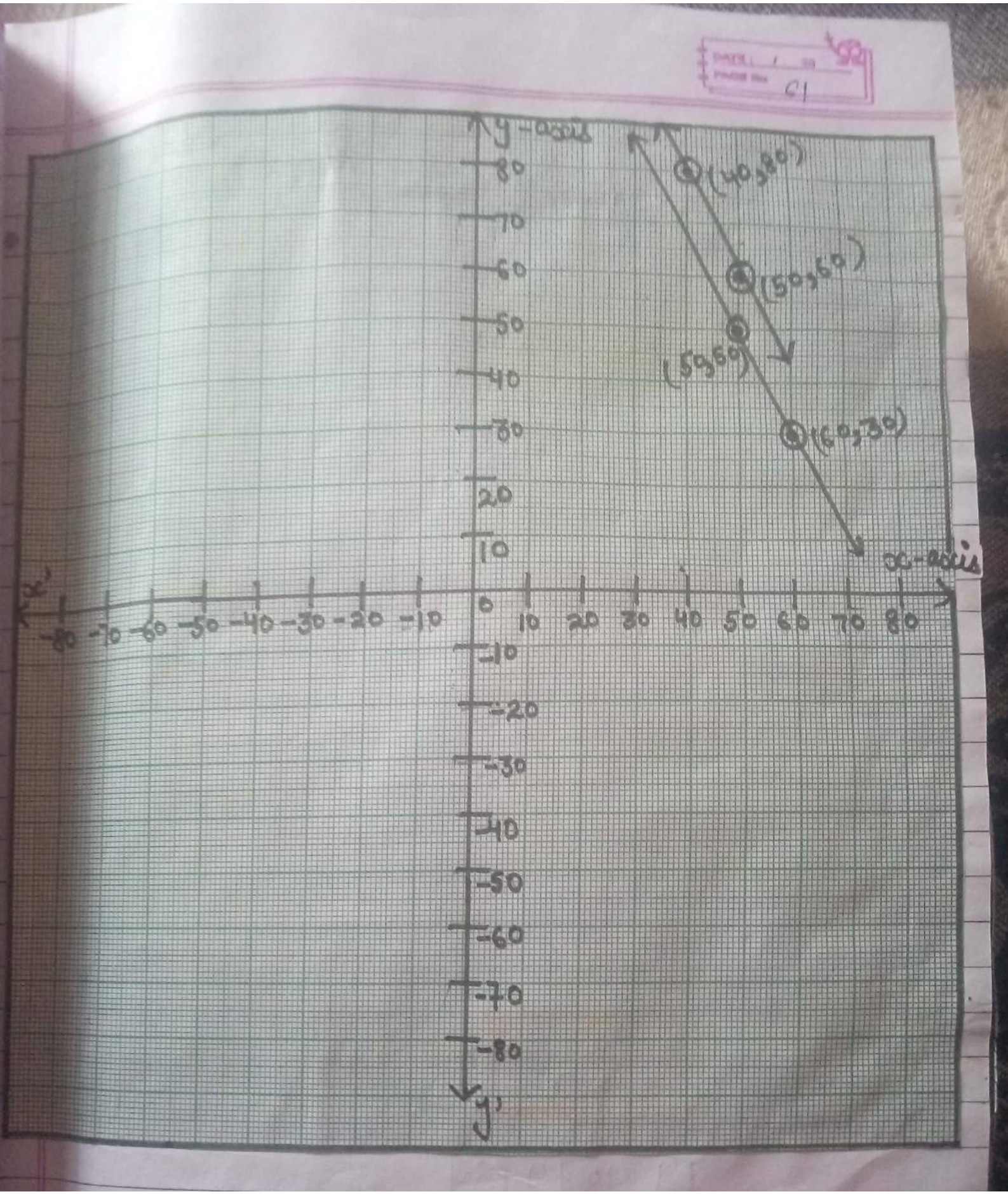

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Ex:- 3.2

Ques (2.) 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 no. of boys. find the no of boys and girls who took part in quiz.

Ans:- Total No. of students = 10

Let the No. of boys = x

Let the no. of girls = y

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

$y = x + 4$ ..... (2)

from eq. (1)

$y = 10 - x$

Put $x = 0$	Put $x = 1$	Put $x = 2$
$y = 10 - 0$	$y = 10 - 1$	$y = 10 - 2$
$y = 10$	$y = 9$	$y = 8$

x	0	1	2
y	10	9	8

from eq (2) :- $(y = x + 4)$

Put $x = 0$	Put $x = 1$	Put $x = 2$
$y = 0 + 4$	$y = 1 + 4$	$y = 2 + 4$
$y = 4$	$y = 5$	$y = 6$

x	0	1	2
y	4	5	6

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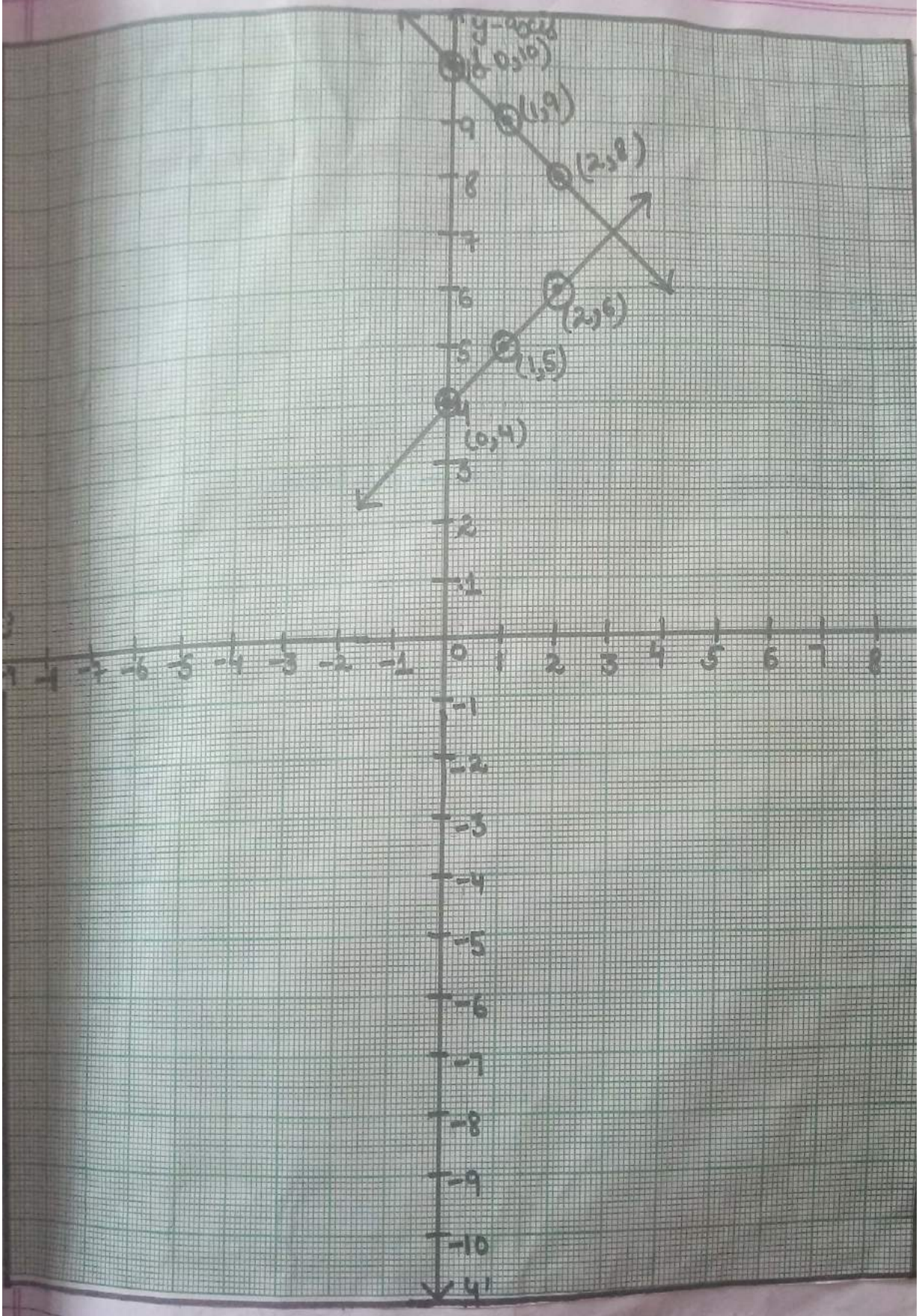

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(iii) 5 pencils and 7 pens together cost Rs. 50, whereas 7 pencils and 5 pens together cost Rs. 46. Find the cost of one pencil and that of one pen.

Sol:- Let the cost of pencil = Rs. x
" " " " Pen = Rs. y

A.T.Q.

$5x + 7y = 50$ — (1)
$7x + 5y = 46$ — (2)

Graph:- $5x + 7y = 50$

$7y = 50 - 5x$

$y = \frac{50 - 5x}{7}$

Put $x = 3$	Put $x = 10$	Put $x = -11$
$y = \frac{50 - 5\times 3}{7}$	$y = \frac{50 - 5\times 10}{7}$	$y = \frac{50 - 5\times(-11)}{7}$
$y = \frac{50 - 15}{7}$	$y = \frac{50 - 50}{7}$	$y = \frac{50 + 55}{7}$
$y = \frac{35}{7}^{5}$	$y = 0$	$y = \frac{105}{7}^{15}$
$y = 5$		$y = 15$

x	3	10	-11
y	5	0	15

$7x + 5y = 46$.

$5y = 46 - 7x$

$y = \frac{46 - 7x}{5}$

Put $x = 3$

$y = \frac{46 - 7\times 3}{5}$

$y = \frac{46 - 21}{5}$

$y = \frac{25}{5}^{5}$

$y = 5$

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Put $x = 8$

$$y = \frac{46 - 7 \times 8}{5}$$

$$y = \frac{46 - 56}{5}$$

$$y = \frac{-10}{5} = -2$$

$y = -2$

Put $x = -2$

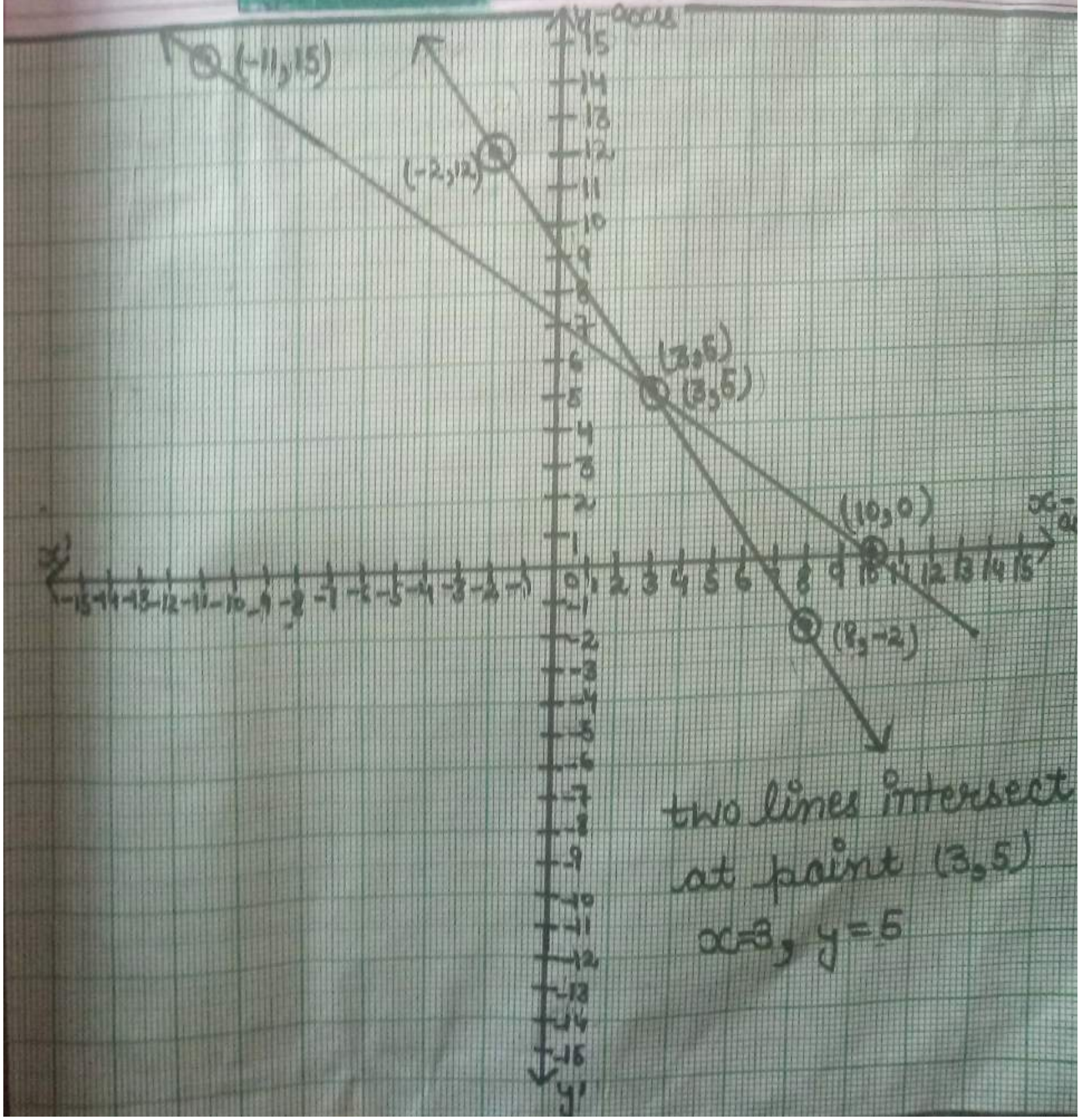
$$y = \frac{46 - 7 \times (-2)}{5}$$

$$y = \frac{46 + 14}{5}$$

$$y = \frac{60}{5} = 12$$

$y = 12$

x	3	8	-2
y	5	-2	12



two lines intersect at point (3, 5)

$x = 3$, $y = 5$

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Que(2):- On comparing the ratio $\frac{a_1}{a_2}, \frac{b_1}{b_2}, \frac{c_1}{c_2}$ find out whether the lines representing the following pairs of linear equation are coincident, intersect or parallel

(i) $5x - 4y + 8 = 0$
$7x + 6y - 9 = 0$

Ans:- $\frac{a_1}{a_2} = \frac{5}{7}$, $\frac{b_1}{b_2} = \frac{-4}{6} = \frac{2}{3}$, $\frac{c_1}{c_2} = \frac{8}{-9}$

$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ (equations intersect at a point)

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

Ans:- $\frac{a_1}{a_2} = \frac{9}{18}$, $\frac{b_1}{b_2} = \frac{3}{6}$, $\frac{c_1}{c_2} = \frac{12}{24}$

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

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

linear equations are coincident

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

Ans:- $\frac{a_1}{a_2} = \frac{6}{2} = 3$, $\frac{b_1}{b_2} = \frac{-3}{-1} = \frac{3}{1}$, $\frac{c_1}{c_2} = \frac{10}{9}$

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

Linear equation are (parallel)

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

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

Sol:- $3x + 2y = 5$ OR $3x + 2y - 5 = 0$

$2x - 3y = 7$ OR $2x - 3y - 7 = 0$

$$\frac{a_1}{a_2} = \frac{3}{2}, \quad \frac{b_1}{b_2} = \frac{2}{-3}, \quad \frac{c_1}{c_2} = \frac{-5}{-7}$$

$$\frac{3}{2} \neq \frac{2}{-3}$$

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

Unique solution and equations are consisten

(ii) $2x - 3y = 8$ OR $2x - 3y - 8 = 0$

$4x - 6y = 9$ OR $4x - 6y - 9 = 0$

Sol:- $\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}$, $\frac{b_1}{b_2} = \frac{-3}{-6} = \frac{1}{2}$, $\frac{c_1}{c_2} = \frac{-8}{-9} = \frac{8}{9}$

$$\frac{1}{2} = \frac{1}{2} \neq \frac{8}{9}$$

$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ No solution, equation are inconsistent

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(iii) $\frac{3}{2}x + \frac{5}{3}y = 7$ OR $\frac{3}{2}x + \frac{5}{3}y - 7 = 0$

$9x - 10y = 14$ OR $9x - 10y - 14 = 0$

Ans:- $\frac{a_1}{a_2} = \frac{\frac{3}{2}}{\frac{9}{1}}$, $\frac{b_1}{b_2} = \frac{\frac{5}{3}}{\frac{-10}{1}}$, $\frac{c_1}{c_2} = \frac{-7 \times 1}{-14 \times 2} = \frac{1}{2}$

$\frac{a_1}{a_2} = \frac{3}{2} \times \frac{1}{9}$, $\frac{b_1}{b_2} = \frac{5}{3} \times \frac{1}{-10}$, $\frac{c_1}{c_2} = \frac{1}{2}$

$\frac{a_1}{a_2} = \frac{3 \times 1}{18 \times 6}$, $\frac{b_1}{b_2} = \frac{5 \times 1}{-30 \times 6}$, $\frac{c_1}{c_2} = \frac{1}{2}$

$\frac{1}{6} \neq \frac{1}{-6} \neq \frac{1}{2}$

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

Unique solution (consistent.)

(iv) $5x - 3y = 11$ OR $5x - 3y - 11 = 0$

$-10x + 6y = -22$ OR $-10x + 6y + 22$

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

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

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

Infinitely sol. (consistent)

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(iv) $\frac{4}{3}x + 2y = 8$ OR $\frac{4}{3}x + 2y - 8 = 0$

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

Ans:- $\frac{a_1}{a_2} = \frac{\frac{4}{3}}{\frac{2}{1}}$, $\frac{b_1}{b_2} = \frac{2}{3}$, $\frac{c_1}{c_2} = \frac{-8}{-12}\frac{2}{3}$

$\frac{a_1}{a_2} = \frac{4}{3} \times \frac{1}{2} = \frac{4}{6} = \frac{2}{3}$, $\frac{b_1}{b_2} = \frac{2}{3}$, $\frac{c_1}{c_2} = \frac{2}{3}$

$\frac{2}{3} = \frac{2}{3} = \frac{2}{3}$

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

Infinitely sol. (consistent) -

Ques (4) Which of the following pairs of linear equations are consistent / inconsistent ? If consistent, obtain the solution graphically.

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

Sol:- $x + y = 5$ ---- (1)

$2x + 2y = 10$ ---- (2)

Dividing equation (2) by on both sides we get

$x + y = 5$

Put $x = 0$	Put $x = 1$
$y = 5 - 0$	$y = 5 - 1$
$y = 5$	$y = 4$

x	0	1
y	5	4

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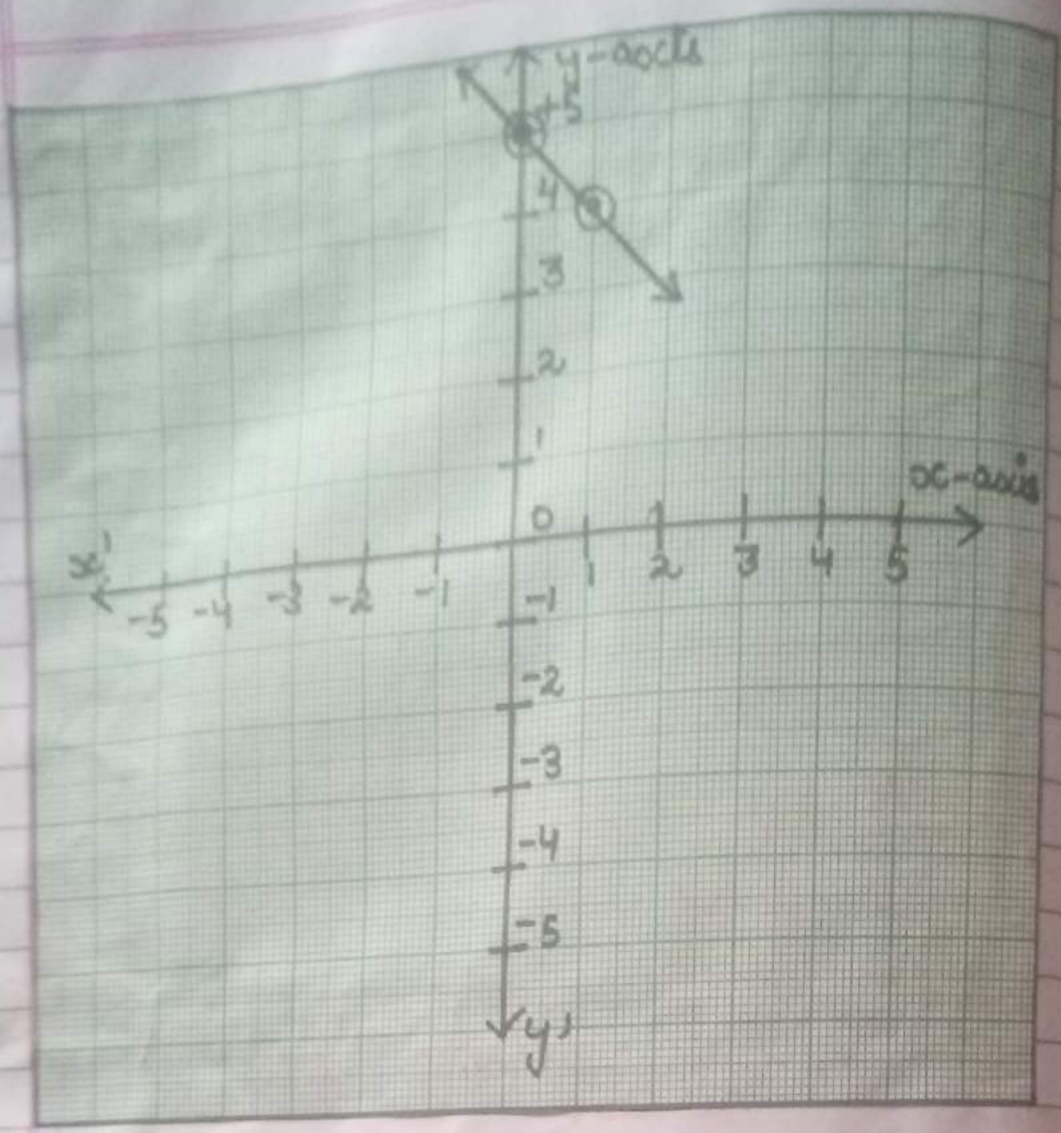

We observe, that the equation (2) has also the s graph. So, the given pair of equations are depende consistent.

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

Ans- $x-y=8$ or $x-y-8=0$ ---(1)

$3x-3y=16$ or $3x-3y-16=0$ ---(2)

$$\frac{a_1}{a_2}=\frac{1}{3},\ \frac{b_1}{b_2}=\frac{-1}{-3}=\frac{1}{3},\ \frac{c_1}{c_2}=\frac{-8}{-16}=\frac{1}{2}$$

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

∴ the given pair of linear equation is inconsistent

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

Ans:- $2x+y-6=0$ ------ (1)

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

$\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}$, $\frac{b_1}{b_2} = \frac{1}{-2}$

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

∴ Therefore, the given pair of linear equation is consistent.

$y = 6-2x$

Put $x=0$

$y = 6-2\times0$

$y = 6-0$

$y = 6$

Put $x=1$

$y = 6-2\times1$

$y = 6-2$

$y = 4$

x	0	1
y	6	4

From equation (2)

$2y = 4x-4$

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

$y = \frac{2(2x-2)}{2}$

$y = 2x-2$

Put $x=0$

$y = 2\times0-2$

$y = 0-2$

$y = -2$

Put $x=1$

$y = 2\times1-2$

$y = 2-2$

$y = 0$

x	0	1
y	-2	0

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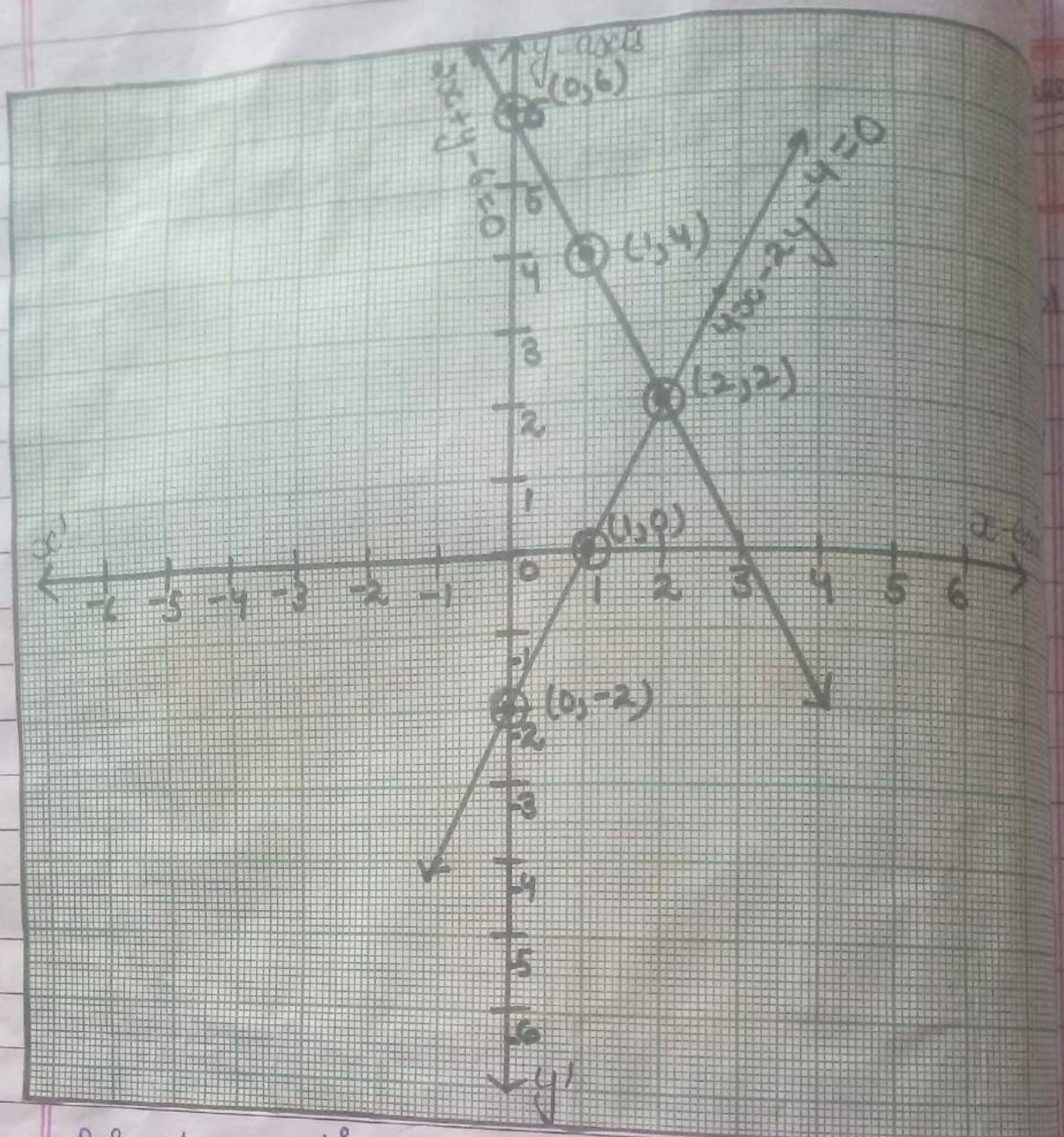

Pair of equation is consistent

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

Ans - $2x - 2y - 2 = 0$ ---- (1)

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

$\frac{a_1}{a_2} = \frac{2}{4} = \frac{1}{2}$, $\frac{b_1}{b_2} = \frac{-2}{-4} = \frac{1}{2}$, $\frac{c_1}{c_2} = \frac{-2}{-5}$

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

∴ Therefore, the given pair of linear equation is inconsistent.

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

Sol. Let the width of a garden = x m and the length of a garden = y m

A.T.Q

$$y = x + 4 \quad \text{---} (1)$$

$$y - x = 4$$

Also $\frac{1}{2}$ (Perimeter of a garden) = 36 m

$$\frac{1}{2}[2(y+x)] = 36\,m \quad \text{---} (2)$$

Adding eq (1) and (2), we get

$$2y = 40$$

$$y = \frac{40}{2} = 20$$

$$y = 20$$

Put $y = 20$ in equation (1), we get

$$20 - x = 4$$

$$x = 20 - 4 = 16$$

Hence, the dimensions of a garden length 20m and the width 16m

Ques(6) Given the linear equations $2x + 3y - 8 = 0$, Write another linear equation in two variables such that the geometries representation of the pair so formed is: (i) Intersecting lines (ii) Parallel lines (iii) Coincident lines

Ans:- Given linear equation is $2x + 3y - 8 = 0$

(i) $3x + 2y - 7 = 0$

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(ii) $2x - 3y - 12 = 0$

(iii) $4x + 6y - 16 = 0$

Ques (v) Draw the graphs of the equation $x - y + 1 = 0$, $3x + 2y - 12 = 0$. Determine the coordinates of the vertices of the triangle formed by these lines and the x-axis and shade the triangular region.

Ans:- $x - y + 1 = 0$

$3x + 2y - 12 = 0$

$y = x + 1$

Put $x = 0$

$y = 0 + 1 = 1$

Put $x = 1$

$y = 1 + 1 = 2$

x	0	1
y	1	2

$2y = 12 - 3x$

$y = \frac{12 - 3x}{2}$

Put $x = 0$

$y = \frac{12 - 3(0)}{2}$

$y = \frac{12 - 0}{2} = \frac{12}{2} = 6$

Put $x = 2$

$y = \frac{12 - 3(2)}{2}$

$y = \frac{12 - 6}{2} = \frac{6}{2} = 3$

x	0	2
y	6	3

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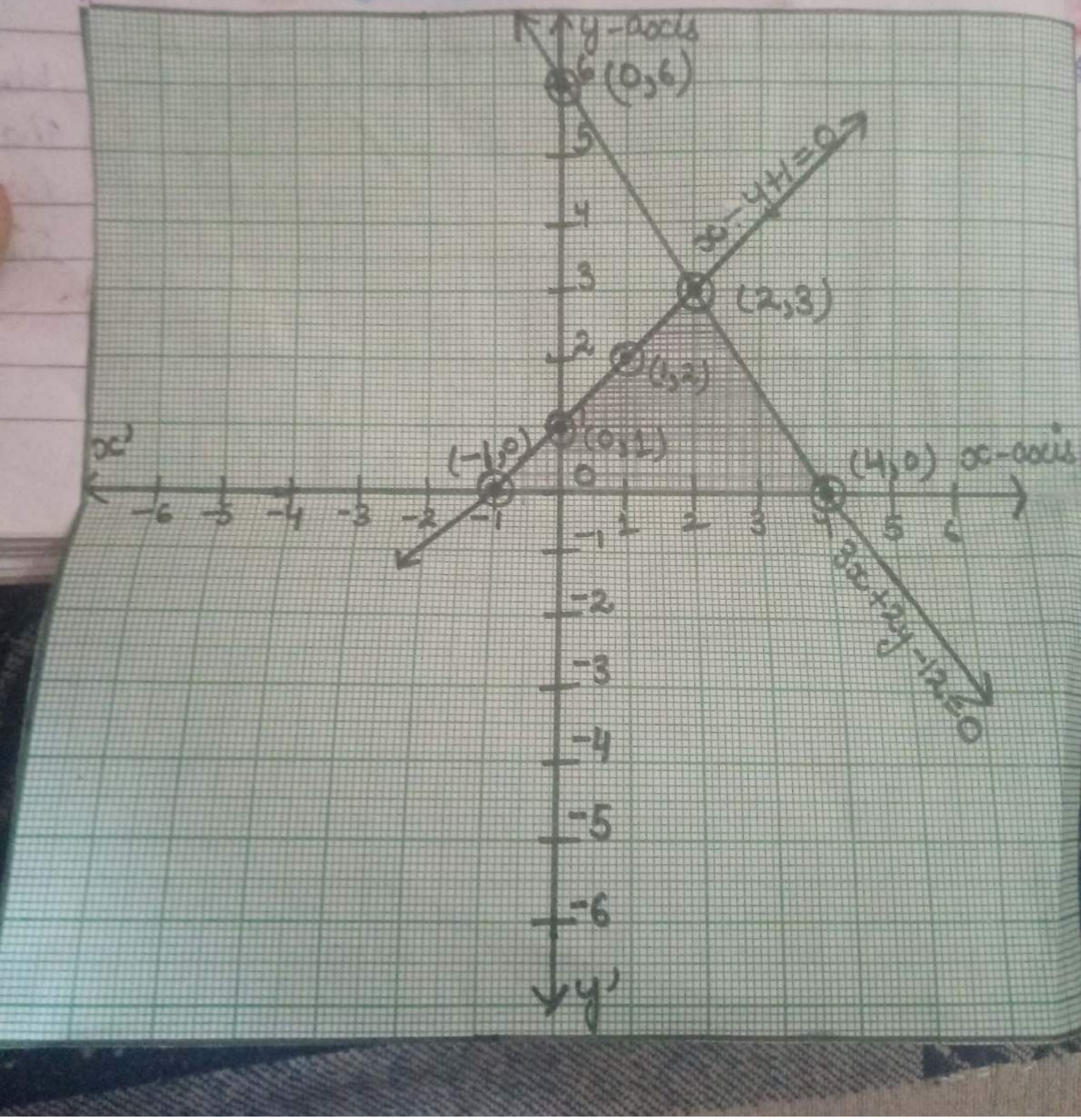
$y \leq 3$



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Ex:- 3.3

Q(iii) Solve the following pairs of linear equations by the substitution method.

(i) $x+y=14$, $x-y=4$

Ans:- $x+y=14$ ---(1)

$x-y=4$ ---(2)

From equation (2), we get

$x=4+y$ ---(3)

Put the value of x in equation (1) we get

$4+y+y=14$

$4+2y=14$

$2y=14-4$

$2y=10$

$y=\frac{10}{2}^{5}$

$y=5$

Put the value of $y=5$ in equation (3), we get

$x=4+5=9$

Hence, $x=9$ and $y=5$

(ii) $s-t=3$, $\frac{s}{3}+\frac{t}{2}=6$

Ans: $s-t=3$ ---(1)

$\frac{s}{3}+\frac{t}{2}=6$ ---(2)

from eq (1), we get

$s=3+t$

Put the value of s in eq (2), we get

$\frac{3+t}{3}+\frac{t}{2}=6$

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$$\frac{2(3+t)+3t}{6} = 6$$

$$\frac{6+2t+3t}{6} = 6$$

$$\frac{6+5t}{6} = 6$$

$$6+5t = 6\times 6$$

$$5t = 36-6$$

$$5t = 30$$

$$t = \frac{30}{5} = 6$$

Put the value of $t=6$ in eq (3), we get

$$s = 3+6 = 9$$

Hence, $s=9$ and $t=6$

(iii) $3x-y=3$; $9x-3y=9$

Ans. $3x-y=3$ ---(1)

$9x-3y=9$ ---(2)

Dividing equation (2) by 3, we get

$3x-y=3$

which is same as equation (1)

From equation (1), we get

$3x = 3+y$

$y = 3x-3$

where x can take any value i.e infinitely many sol.

(iv) $0.2x+0.3y=1.3$, $0.4x+0.5y=2.3$

Ans. $0.2x+0.3y=1.3$ ---(1)

$0.4x+0.5y=2.3$ ---(2)

from eq. (1), we get

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$$0.2x = 1.3 - 0.3y$$

$$x = \frac{1.3 - 0.3y}{0.2}$$

Put the value of x in eq. (2) we get

$$0.4\left(\frac{1.3 - 0.3y}{0.2}\right) + 0.5y = 2.3$$

$$2(1.3 - 0.3y) + 0.5y = 2.3$$

$$2.6 - 0.6y + 0.5y = 2.3$$

$$-0.1y = 2.3 - 2.6$$

$$-0.1y = -0.3$$

$$y = 3$$

Put the value of y in equation (3), we get

$$x = \frac{1.3 - 0.3(3)}{0.2}$$

$$x = \frac{1.3 - 0.9}{0.2}$$

$$x = \frac{0.4}{0.2}$$

$$x = 2$$

Hence, $x = 2$ and $y = 3$

(v.) $\sqrt{2}x + \sqrt{3}y = 0$, $\sqrt{3}x - \sqrt{8}y = 0$

And $\sqrt{2}x + \sqrt{3}y = 0$ ---- (1)

$\sqrt{3}x - \sqrt{8}y = 0$ ---- (2)

from eq (1), we get

$$\sqrt{2}x = -\sqrt{3}y$$

$$x = \frac{-\sqrt{3}y}{\sqrt{2}} \quad \text{---- (3)}$$

Put the value of x in eq (2), we get

$$\sqrt{3}\left(\frac{-\sqrt{3}}{\sqrt{2}}\right)y - \sqrt{8}y = 0$$

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$$-\frac{3}{\sqrt{2}}y - \sqrt{8}y = 0$$

$$y\left(-\frac{3}{\sqrt{2}} - \sqrt{8}\right) = 0$$

Put the value of y in eq. (3), we get

$$x = -\frac{\sqrt{3}}{\sqrt{2}}(0) = 0$$

Hence, $x = 0$ and $y = 0$

(vi) $\frac{3x}{3} - \frac{5y}{3} = -2$, $\frac{x}{3} + \frac{y}{2} = \frac{13}{6}$

Ans:- $\frac{3x}{2} - \frac{5y}{3} = -2$ ----(1)

$$\frac{x}{3} + \frac{y}{2} = \frac{13}{6}$$ ----(2)

from eq (2), we get

$$\frac{x}{3} + \frac{y}{2} = \frac{13}{6}$$

$$\frac{2x + 3y}{6} = \frac{13}{6}$$

$$2x + 3y = \frac{13}{6} \times 6$$

$$2x + 3y = 13$$

$$2x = 13 - 3y$$

$$x = \frac{13 - 3y}{2}$$ ----(3)

Put the value of x in eq (1), we get

$$\frac{3}{2}\left(\frac{13 - 3y}{2}\right) - \frac{5y}{3} = -2$$

$$\frac{39 - 9y}{4} - \frac{5y}{3} = -2$$

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$$\frac{3(39-9y)-20y}{12} = -2$$

$$117 - 27y - 20y = -2 \times 12$$

$$117 - 47y = -24$$

$$117 + 24 = 47y$$

$$47y = 141$$

$$y = \frac{141}{47} = 3$$

Put the value of y in equation (3), we get

$$x = \frac{(3-3(3)}{2} = \frac{13-9}{2} = \frac{4}{2} = 2$$

Hence, $x = 2$, $y = 3$

Question) Solve $2x + 3y = 11$ and $2x - 4y = -24$ and hence find the value of m for which $y = mx + 3$

Ans:- Given equations are

$$2x + 3y = 11 \quad ---(1)$$

$$2x - 4y = -24 \quad ----(2)$$

Dividing eq.(2) by 2, we get

$$x - 2y = -12$$

$$x = -12 + 2y \quad ----(3)$$

Put the value of x in eq.(1) we get

$$2(-12 + 2y) + 3y = 11$$

$$-24 + 4y + 3y = 11$$

$$7y = 11 + 24$$

$$7y = 35$$

$$y = \frac{35}{7} 5 = 5$$

Put the value of y in eq.(3), we get

$$x = -12 + 2(5)$$

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$x = -12 + 10 = -2$

$y = mx + 3$ (Given) ---(4)

Put the value of x and y in eq. (4), we get

$5 = m(-2) + 3$

$-2m = 5 - 3$

$-2m = 2$

$m = -1$

Hence, $x = -2$, $y = 5$ and $m = -1$

Ques 13) From the pair of linear eq. for the following problem find their solution by substitution method.

(i) The diff. between two no. is 26 and one No. is 3 times other. Find them.

Ansr Let x and y be two given No.

A.T.Q

$x - y = 26$ ---(1)

$x = 3y$ ---(2)

Put the value of x from eq. (2) in eq. (1), we get

$3y - y = 26$

$2y = 26$

$y = \frac{26}{2} = 13$

$= 13$

Put the value of y in eq. (2), we get

$x = 3 \times 13 = 39$

Hence, the required numbers are 39 and 13

(ii) The larger of two supplymentary angles exceeds the smaller by 18 degrees. Find them.

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Let x and y be two given supplementary angles

A.T.Q $x + y = 180°$ ---(1)

$x = y + 18°$ ---(2)

Put the value of x from eq (2) in eq (1), we get

$y + 18 + y = 180°$

$2y = 180° - 18$

$2y = 162°$

$y = \frac{162}{2} = 81°$

Put the value of y in eq. (1), we get

$x + 81° = 180°$

$x = 180° - 81°$

$x = 99°$

Hence, the required angles are 99° and 81°

ii) The coach of a cricket team buys 7 bats and 6 balls for Rs. 3800 later she buys 3 bats and 5 balls for Rs. 1750. Find the cost of each bat and each ball.

Let the cost of one bat = Rs. x

" " " " " ball = Rs. y

A.T.Q $7x + 6y = 3800$ ---(1)

$3x + 5y = 1750$ ---(2)

From equation (2), we get

$3x = 1750 - 5y$

$x = \frac{1750 - 5y}{3}$ ----(3)

Put the value of x in eq. (1), we get

$7\left(\frac{1756 - 5y}{3}\right) + 6y = 3800$

$= \frac{12250 - 35y}{3} + 6y = 3800$

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$= \frac{12250 - 35y + 18y}{3} = 3800$

$= \frac{12250 - 17y}{3} = 3800$

$= 12250 - 17y = 3800 \times 3$

$= 12250 - 17y = 11400$

$= 12250 - 11400 = 17y$

$= 17y = 850$

$= y = \frac{850}{17} = 50$

Put the value of y in eq. (3), we get

$x = \frac{1750 + 5 \times 50}{3}$

$x = \frac{1750 - 250}{3}$

$x = \frac{1500}{3} = 500$

Hence, the cost of each bat = Rs. x = Rs. 500 and of each ball = Rs. y = Rs. 50

(iv.) The taxi charges in a city consist of a fixed charge together with the charge for the distance covered for a distance of 10 km, the charge paid is Rs and for a journey of 15 km, the charges paid is 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?

Ans

Let the fixed charges of a taxi = Rs. x and charges for one km of distance = Rs. y

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A.T.Q $x + 10y = 105$ ... (1)

$x + 15y = 155$ ... (2)

From eq. (1), we get

$x = 105 - 10y$ ... (3)

Put the value of x in eq. (2), we get

$105 - 10y + 15y = 155$

$5y = 155 - 105$

$5y = 50$

$y = \frac{50}{5} = 10$

Put the value of y in eq. (3), we get

$x = 105 - 10 \times 10$

$x = 105 - 100 = 5$

Therefore, the fixed charges of a taxi = Rs. 5 Ans

and charges per km = Rs. 10

- Payment paid by the person for travelling a distance of 25 km.

$= Rs.\ (x + 25y) = Rs.\ (5 + 25 \times 10)$

$= Rs.\ (5 + 250) = Rs.\ 255$ Ans.

(v) 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 $\frac{5}{6}$. Find the fraction.

Ans:- Let the given fraction = $\frac{x}{y}$

A.T.Q $\frac{x+2}{y+2} = \frac{9}{11}$

$\frac{x+3}{y+3} = \frac{5}{6}$

from eq. (1), we get

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$11(x+2) = 9(y+2)$

$11x + 22 = 9y + 18$

$11x = 9y + 18 - 22$

$11x = 9y - 4$

$x = \frac{9y-4}{11}$

From equation (2), we get

$6(x+3) = 5(y+3)$

$6x + 18 = 5y + 15$

$6x = 5y + 15 - 18$

$6x = 5y - 3$

Put the value of x from eq. (3) in eq (4), we get

$6\left(\frac{9y-4}{11}\right) = (5y-3)$

$6(9y-4) = 11(5y-3)$

$54y - 24 = 55y - 33$

$54y - 55y = -33 + 24$

$-y = -9$

$y = 9$

Put the value of y in eq. (3), we get

$x = \frac{9(9)-4}{11}$

$x = \frac{81-4}{11} = \frac{77}{11} = 7$

Hence, the required fraction is $\frac{x}{y} = \frac{7}{9}$

(vi) 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. What are their present ages?

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Sol:- Let the present age of Jacob = x years
and " " " " Son = y years
5 years hence
age of Jacob = (x+5) years
" " Son = (y+5) years
by the first condition
$$(x+5) = 3(y+5)$$
$$x+5 = 3y+15$$
$$x = 3y+15-5$$
$$x = 3y+10 \quad ---(1)$$
5 years ago,
Age of Jacob = (x-5) years
" " Son = (y-5) years
by the second condition,
$$x-5 = 7(y-5)$$
$$x-5 = 7y-35 \quad ---(2)$$
Put the value of x from eq.(1) in eq.(2), we get
$$(3y+10)-5 = 7y-35$$
$$3y+10-5 = 7y-35$$
$$3y+5 = 7y-35$$
$$3y-7y = -35-5$$
$$-4y = -40$$
$$y = \frac{-40}{-4}$$
$$y = 10$$
Put the value of y in eq.(1), we get
$$x = 3(10)+10$$
$$x = 30+10$$
$$x = 40$$
Hence, the present age of Jacob = 40 years Ans
And the present age of Son = 10 years

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Ex :- 3.4

Ques 1) Solve the following pair of linear equation by the elimination method and the substitution method:

(i) $x+y=5$ and $2x-3y=4$

Ans- Given linear equation are

$$x+y=5 \quad ----(1)$$

$$2x-3y=4 \quad ----(2)$$

Elimination method:-

Multiplying equation (1) by 2, we get

$$2x-3y=4 \quad ----(3)$$

Subtracting equation (3) from equation (2), we get

$$(2x-3y)-(2x+2y)=4-10$$

$$2x-3y-2x-2y=6$$

$$-5y=-6$$

$$y=\frac{6}{5}$$

Put the value of y in equation (1), we get

$$x+\frac{6}{5}=5$$

$$x=5-\frac{6}{5}$$

$$x=\frac{25-6}{5}$$

$$x=\frac{19}{5}$$

Hence, the required solution is $x=\frac{19}{5}$, $y=\frac{6}{5}$

Substitution Method:-

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From equation (1), we get

$$y = 5 - x$$

Put the value of y in equation (2), we get

$$2x - 3(5 - x) = 4$$

$$2x - 15 + 3x = 4$$

$$5x - 15 = 4$$

$$5x = 4 + 5 = 19$$

$$5x = 19$$

$$x = \frac{19}{5}$$

Put the value of x in equation (3), we get

$$y = 5 - \frac{19}{5}$$

$$y = \frac{25 - 19}{5} = \frac{6}{5}$$

Hence the required solution is $x = \frac{19}{5}$ and $y = \frac{6}{5}$

(ii) $3x + 4y = 10$ and $2x - 2y = 2$

Ans:- Given linear equations are

$$3x + 4y = 10 \quad \text{----(1)}$$

$$2x - 2y = 2 \quad \text{----(2)}$$

equation (2) can be rewritten as

$$x - y = 1 \quad \text{----(3)}$$

(dividing eq(2) by 2)

Elimination Method:-

Multiplying equation (3) by 3, we get

$$3x - 3y = 3 \quad \text{----(4)}$$

Substracting equation (4) from eq (1), we get

$$(3x + 4y) - (3x - 3y) = 10 - 3$$

$$3x + 4y - 3x + 3y = 7$$

$$7y = 7$$

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$y = \frac{7}{7} = 1$

$\boxed{y = 1}$

Put the value of y in eq (1), we get

$3x + 4(1) = 10$

$3x = 10 - 4 = 6$

$3x = 6$

$x = \frac{6}{3} = 2$

Hence required sol. is $x = 2$ and $y = 1$

Substitution Method:-

From equation (3), we get

$x = 1 + y$ ------ (4)

Put the value of x in equation (1), we get

$3(1+y) + 4y = 10$

$3 + 3y + 4y = 10$

$7y = 10 - 3$

$7y = 7$

$y = \frac{7}{7} = 1$

Put the value of y in eq (4), we get

$x = 1 + 1 = 2$

Hence, the required solution is $x = 2$ and $y = 1$

ii) $3x - 5y - 4 = 0$ and $9x = 2y + 7$

Sol:- Given linear equation are

$3x - 5y - 4 = 0$ ------ (1)

$9x = 2y + 7$ ------ (2)

Elimination Method:-

Equation (1) and (2) can be rewritten as

$3x - 5y = 4$

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$9x - 2y = 7$

Multiplying eq.(3) by 3, we get

$9x - 15y = 12$

Substracting eq.(5) from eq.(4), we get

$(9x - 2y) - (9x - 15y) = 7 - 12$

$9x - 2y - 9x + 15y = -5$

$13y = -5$

$y = \frac{-5}{13}$

Put the value of y in equation (3), we get

$3x - 5\left(\frac{-5}{13}\right) = 4$

$3x + \frac{25}{13} = 4$

$3x = 4 - \frac{25}{13}$

$3x = \frac{52 - 25}{13} = \frac{27}{13}$

$x = \frac{9}{\cancel{27}} \times \frac{1}{\cancel{3}} = \frac{9}{13}$

Hence, the required sol. is $x = \frac{9}{13}$ and $y = \frac{-5}{13}$

Substitution Method :-

From eq.(2), we get

$x = \frac{2y + 7}{9}$

Put the value of x in eq.(1), we get

$\cancel{3}\left(\frac{2y + 7}{\cancel{9}_3}\right) - 5y - 4 = 0$

$\frac{2y + 7}{3} - 5y = 4$

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$$7-13y=12$$
$$-13y=12-7$$
$$-13y=5$$
$$y=\frac{-5}{13}$$

Put the value of y in eq. (3), we get

$$x=\frac{2\times\left(\frac{-5}{13}\right)+7}{9}$$

$$x=\frac{\frac{-10}{13}+7}{9}$$

$$x=\frac{(-10+91)\times\frac{1}{13}}{9}$$

$$x=\frac{81}{13}\times\frac{1}{9}=\frac{9}{13}$$

Hence the required solution is $x=\frac{9}{13}$ and $y=$

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

Ans:- Given equation are

$$\frac{x}{2}+\frac{2y}{3}=-1 \quad \text{-----(1)}$$

$$x-\frac{y}{3}=3 \quad \text{---(2)}$$

Eq. (1) and (2) can be rewritten as

$$3x+4y=-6 \quad \text{---(3)}$$

(Multiplying Eq. (1) by 6)

$$3x-y=9 \quad \text{---(4)}$$

(Multiplying eq. (2) by 3)

Elimination method:-

Substracting eq. (4) from eq. (3), we get

$$(3x+4y)-(3x-y)=-6-9$$

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$$3x + 4y - 3x + y = -15$$
$$5y = -15$$
$$y = \frac{-15}{5}$$
$$y = -3$$

Put the value of y in eq. (3), we get

$$3x + 4(-3) = -6$$
$$3x - 12 = -6$$
$$3x = -6 + 12$$
$$3x = 6$$
$$x = \frac{6^2}{3} = 2$$

Hence, the required solution is $x = 2$ and $y = -3$

Substitution method:- From eq. (4), we get

$$y = 3x - 9$$

Put the value of y in eq. (3), we get

$$3x + 4(3x - 9) = -6$$
$$3x + 12x - 36 = -6$$
$$15x = -6 + 36$$
$$15x = 30$$
$$x = \frac{30^2}{15}$$
$$x = 2$$

Put the value of x in eq. (5), we get

$$y = 3(2) - 9$$
$$y = 6 - 9$$
$$y = -3$$

Hence, the required solution is $x = 2$ and $y = -3$

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Ques (2) form the pair of linear equation in the following and find their solutions (if they exist) by the elimination method.

(i) If we add 1 to the numerator and Substract 1 from denominator, a fraction reduces to 1. If becomes $\frac{1}{2}$ we only add 1 to the denominator, what is the fraction.

Ans:- Let the given fraction $= \frac{x}{y}$

A.T.Q - $\frac{x+1}{y-1} = 1$

$x+1 = y-1$

$x-y = -1-1$

$x-y = -2$ ----(1)

A.T.Q :- $\frac{x}{y+1} = \frac{1}{2}$

$2x = y+1$

$2x-y = 1$ ----(2)

by substracting equation (2) from eq. (1), we

$(x-y)-(2x-y) = -2-1$

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

$-x = -3$

$x = 3$

Put the value of x in eq. (1), we get

$3-y = -2$

$3+2 = y$

$5 = y$

$y = 5$

Hence, the required fraction $= \frac{x}{y} = \frac{3}{5}$

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(iii) 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?

Ans:- Let the present age of Nuri = x years
and " " " " Sonu = y years

5 years ago,

Age of Nuri = $(x-5)$ years
and " " Sonu = $(y-5)$ years

A.T.Q

$$x-5 = 3(y-5)$$
$$x-5 = 3y-15$$
$$x-3y = -15+5$$
$$x-3y = -10 \quad ----(1)$$

Ten years ~~ago~~ later,

Age of Nuri = $(x+10)$ years
and " " Sonu = $(y+10)$ years

A.T.Q

$$x+10 = 2(y+10)$$
$$x+10 = 2y+20$$
$$x-2y = 20-10$$
$$x-2y = 10 \quad ----(2)$$

by substracting eq.(2) from eq.(1), we get

$$(x-3y)-(x-2y) = -10-10$$
$$x-3y-x+2y = -20$$
$$-y = -20$$
$$y = 20$$

Put the value of y in eq.(1), we get

$$x-3(20) = -10$$
$$x-60 = -10$$
$$x = -10+60$$
$$x = 50$$

Hence, the present age of Nuri = $x = 50$ years
and " " " " Sonu = $y = 20$ years] Ans

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(iii) The sum of the digits of a two-digit number is 9. Nine times this no. is twice the no. obtained by reversing order of the digits. Find the No.

Sol:- Let the unit place of a two digit No. = x
and " tens " " " " " = y
∴ Original No. formed = 10y + x
We have,
x + y = 9 ---- (1)
by reversing the digits, New no. = 10x + y
We have, 9(10y + x) = 2(10x + y)
90y + 9x = 20x + 2y
90y + 9x - 20x - 2y = 0
-11x + 88y = 0
Dividing it by 11, we get
-x + 8y = 0 ---------- (2)
by adding (1) and (2), we get
(x + y) + (-x + 8y) = 9 + 0
x + y - x + 8y = 9
9y = 9
y = 9/9
y = 1
Put the value of y in eq. (1), we get
x + 1 = 9
x = 9 - 1 = 8
Hence, the original No. = 10y + x
= 10(1) + 8
= 10 + 8 = 18

(iv) Meena went to a bank to withdraw Rs. 2000. She asked the cashier to give her Rs. 50 and Rs. 100 note only. Meena got 25 notes. Find how many notes of Rs. 50 and Rs. 100. She wa

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Ans:- Let the No. of notes Rs. 50 = x
And " " " " Rs. 100 = y

A.T.Q $50x + 100y = 2000$

Dividing it by 50, we get

$x + 2y = 40$ ------ (1)

A.T.Q :-

$x + y = 25$ ---- (2)

by substracting eq. (2) from eq. (1), we get

$(x + 2y) - (x + y) = 40 - 25$

$x + 2y - x - y = 15$

$y = 15$

Put the value of y in eq. (1), we get

$x + 2 \times 15 = 40$

$x + 30 = 40$

$x = 40 - 30$

$x = 10$

Hence, the No of notes of Rs. 50 = x = 10 } Ans
and " " " " " Rs. 100 = y = 15 }

(v) A lending library has a fixed charge for the first three days and an additional charge for each day thereafter. Saritha paid Rs. 27 for a book kept for seven days, while Susy paid Rs. 21 for the book she kept fore five days. Find the fixed charge and the charge for each extra day.

Ans:- Let the fixed charges of a library for first three days = Rs. x

and the additional charges per day therefore = Rs. y

A.T.Q

$x + 4y = 27$ --- (1)

$x + 2y = 21$ ---- (2)

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Subtracting eq. (2) from eq. (1), we get

$$(x+4y)-(x+2y)=27-21$$

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

$$2y=6$$

$$y=\frac{6}{2}$$

$$y=3$$

Put the value of y in eq. (1), we get

$$x+4\times3=27$$

$$x+12=27$$

$$x=27-12=15$$

Hence, the fixed charges for the first three days = ₹ = Rs. 15

and the charge for each extra day = Rs. y = Rs. 3

Ans

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Ex:- 3.5

Q.(1) Which of the following pairs of linear equation has unique solution, no solution or infinitely many solutions. In case there is a unique sol. find it by cross multiplication method.

i) $x - 3y - 3 = 0$, $3x - 9y - 2 = 0$

Ans:- Given linear equations are

$$x - 3y - 3 = 0 \quad \text{------(1)}$$

$$3x - 9y - 2 = 0 \quad \text{------(2)}$$

$$\frac{a_1}{a_2} = \frac{1}{3}, \quad \frac{b_1}{b_2} = \frac{-3}{-9} = \frac{1}{3}, \quad \frac{c_1}{c_2} = \frac{-3}{-2} = \frac{3}{2}$$

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

Hence the given pair of linear equations has no sol.

ii) $2x + y = 5$, $3x + 2y = 8$

Ans:- Given linear equations are

$$2x + y = 5 \quad \text{------(1)}$$

$$3x + 2y = 8 \quad \text{------(2)}$$

Eq. (1) and (2) can be written as,

$$2x + y - 5 = 0 \quad \text{------(3)}$$

$$3x + 2y - 8 = 0 \quad \text{------(4)}$$

$$\frac{a_1}{a_2} = \frac{2}{3}, \quad \frac{b_1}{b_2} = \frac{1}{2}, \quad \frac{c_1}{c_2} = \frac{-5}{-8} = \frac{5}{8}$$

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

∴ The given pair of linear equations has a unique so

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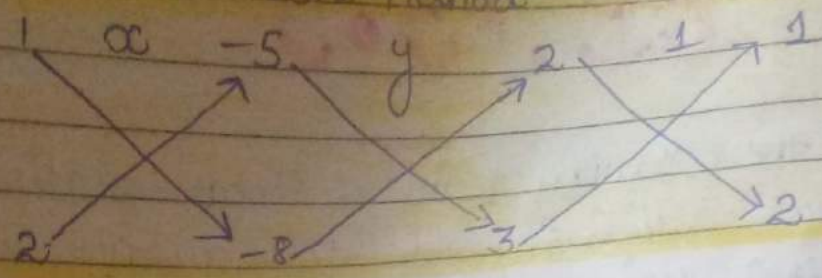
2312 Method



$$\frac{x}{(1)(-8)-(2)(-5)} = \frac{y}{(-5)(3)-(-8)(2)} = \frac{1}{(2)(2)-(3)(1)}$$

$$\frac{x}{-8+10} = \frac{y}{-15+16} = \frac{1}{4-3}$$

$$\frac{x}{2} = \frac{y}{1} = \frac{1}{1}$$

$$\frac{x}{2} = \frac{1}{1} \text{ and } \frac{y}{1} = \frac{1}{1}$$

$x = 2$ and $y = 1$

(iii) $3x - 5y = 20$, $6x - 10y = 40$

Ans: Given linear equation are

$3x - 5y = 20$ ----- (1)

$6x - 10y = 40$ ----- (2)

$3x - 5y - 20 = 0$ ----- (3)

$6x - 10y - 40 = 0$ ----- (4)

$\frac{a_1}{a_2} = \frac{3}{6} = \frac{1}{2}$, $\frac{b_1}{b_2} = \frac{-5}{-10} = \frac{1}{2}$, $\frac{c_1}{c_2} = \frac{-20}{-40} = \frac{1}{2}$

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

Hence, the given pair of linear equations are infinitely many sol.

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(iv) $x - 3y - 7 = 0$, $3x - 3y - 15 = 0$

Ans. Given linear equations are

$$x - 3y - 7 = 0 \quad \text{----(1)}$$

$$3x - 3y - 15 = 0 \quad \text{----(2)}$$

Dividing equation (2) by 3, we get

$$x - y - 5 = 0 \quad \text{----(3)}$$

$$\frac{a_1}{a_2} = \frac{1}{1} = 1 \;,\; \frac{b_1}{b_2} = \frac{-3}{-1} = 3 \;,\; \frac{c_1}{c_2} = \frac{-7}{-5} = \frac{7}{5}$$

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

∴, the given pair of linear equation has a unique sol.

$$-3 \quad x \quad -7 \qquad y \quad 1 \qquad 1 \quad -3$$

$$-1 \qquad -5 \qquad 1 \qquad -1$$

$$\frac{x}{(-3)(-5)-(-1)(-7)} = \frac{y}{(-7)(1)-(-5)(1)} = \frac{1}{(1)(-1)-(1)(-3)}$$

$$\frac{x}{15-7} = \frac{y}{-7+5} = \frac{1}{-1+3}$$

$$\frac{x}{8} = \frac{y}{-2} = \frac{1}{2}$$

$$\frac{x}{8} = \frac{1}{2} \text{ and } \frac{y}{-2} = \frac{1}{2}$$

$$x = \frac{8}{2} \text{ and } y = \frac{-2}{2}$$

$$x = 4 \text{ and } y = -1$$

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Ex: 3.6

Question

(i) $\frac{1}{2x} + \frac{1}{3y} = 2$

$\frac{1}{3x} + \frac{1}{2y} = \frac{13}{6}$

Ans: Let the $\frac{1}{x} = a$ and $\frac{1}{y} = b$

$\frac{a}{2} + \frac{b}{3} = 2$

OR $\frac{3a + 2b}{6} = 2$

$3a + 2b = 2 \times 6$

$3a + 2b = 12$ ------(1)

$\frac{a}{3} + \frac{b}{2} = \frac{13}{6}$

$\frac{2a + 3b}{6} = \frac{13}{6}$

$2a + 3b = \frac{13}{6} \times 6$

$2a + 3b = 13$

Multiplying eq (1) by 3 and eq (2) by (2) we

$9a + 6b = 36$ ---(3)

$-4a + 6b = 26$ ----(4)

$5a = 10$

$a = \frac{10}{5}2$

$\boxed{a = 2}$

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Put the value of $a = 2$ in eq (1)

$$3a + 2b = 12$$
$$3 \times 2 + 2b = 12$$
$$6 + 2b = 12$$
$$2b = 12 - 6$$
$$2b = 6$$
$$b = \frac{6}{2} 3$$

$$\boxed{b = 3}$$

$\therefore a = 2, b = 3$

but $\frac{1}{x} = a$

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

$$\boxed{x = \frac{1}{2}}$$

$$b = \frac{1}{y}$$

$$3 = \frac{1}{y}$$

$$3y = 1$$

$$\boxed{y = \frac{1}{3}}$$

$x = \frac{1}{2}$ or $y = \frac{1}{3}$

get

(ii) $\frac{2}{\sqrt{x}} + \frac{3}{\sqrt{y}} = 2$ and $\frac{4}{\sqrt{x}} - \frac{9}{\sqrt{y}} = -1$

Sol: Put $\frac{1}{\sqrt{x}} = a$ and $\frac{1}{\sqrt{y}} = b$

$$2a + 3b = 2 \quad ---- (1)$$

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4a − 9b = 1 ... (1)

Multiplying eq (1) by 4 and eq (2) by 2

8a + 12b = 8

8a − 18b = −2

30b = 10

$b = \frac{10}{30}$

$b = \frac{1}{3}$

Put the value of b in (1)

$2a + 3 \times \frac{1}{3} = 2$

2a + 1 = 2

2a = 2 − 1

2a = 1

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

But $a = \frac{1}{\sqrt{x}}$

$\frac{1}{2} = \frac{1}{\sqrt{x}}$

$\sqrt{x} = 2$

Squaring both sides

$(\sqrt{x})^2 = (2)^2$

$x = 4$

$b = \frac{1}{\sqrt{y}}$

$\frac{1}{3} = \frac{1}{\sqrt{y}}$

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$\sqrt{y} = 3$

Sq. both sides

$(\sqrt{y})^2 = (3)^2$

$y = 9$

(ii) $\frac{4}{x} + 3y = 14$ and $\frac{3}{x} - 4y = 23$

Ans:- Let $\frac{1}{x} = a$

$4a + 3y = 14 \quad ---(1)$

$3a - 4y = 23 \quad ---(2)$

Multiply eq (1) by 3 and eq. (2) by 4

$12a + 9y = 42$

$12a - 16y = 92$

$\ominus \quad \oplus \quad \ominus$

$25y = -50$

$y = \frac{-50}{25}$

$y = -2$

Put the value of $y = -2$ in eq. (1)

$4a + 3x(-2) = 14$

$4a - 6 = 14$

$4a = 14 + 6$

$4a = 20$

$a = \frac{20}{4}$

$a = 5$

But $a = \frac{1}{x}$

$\frac{5}{1} = \frac{1}{x}$

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$5x = 1$

$$\boxed{x = \frac{1}{5}}$$

$x = \frac{1}{5}$, $y = -2$

(iv) $\frac{5}{x-1} + \frac{1}{y-2} = 2$ and $\frac{6}{x-1} - \frac{3}{y-2} = 1$

Ans:- Put $\frac{1}{x-1} = a$ and $\frac{1}{y-2} = b$

$$\left.\begin{matrix} 5a + 1b = 2 \\ 6a - 3b = 1 \end{matrix}\right] \begin{matrix} \times 3 \\ \times 1 \end{matrix} \quad \begin{matrix} ---(1) \\ ---(2) \end{matrix}$$

$15a + 3b = 6$

$6a - 3b = 1$

$21a = 7$

$a = \frac{7}{21}$

$$\boxed{a = \frac{1}{3}}$$

Put this value $a = \frac{1}{3}$ in eq. (1)

$5a + 1b = 2$

$5 \times \frac{1}{3} + 1b = 2$

$\frac{5}{3} + 1b = 2$

$1b = 2 - \frac{5}{3}$

$b = \frac{6-5}{3}$

$$\boxed{b = \frac{1}{3}}$$

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Put $\frac{1}{x-1} = a$

$\frac{1}{x-1} \times \frac{1}{3}$

$1 \times (x-1) = 3 \times 1$

$x - 1 = 3$

$x = 3 + 1$

$x = 4$

$\frac{1}{y-2} = b$

$\frac{1}{y-2} \times \frac{1}{3}$

$y - 2 = 3 \times 1$

$y - 2 = 3$

$y = 3 + 2$

$y = 5$

(v) $\frac{7x - 2y}{xy} = 5$ and $\frac{8x + 7y}{xy} = 15$

Ans: $\frac{7x}{xy} - \frac{2y}{xy} = 5$ and $\frac{8x}{xy} + \frac{7y}{xy} = 15$

$\frac{7}{y} - \frac{2}{x} = 5$ and $\frac{8}{y} + \frac{7}{x} = 15$

Put

$\frac{1}{x} = a$ and $\frac{1}{y} = b$

$7b - 2a = 5$ ---(1) $\times 8$

$8b + 7a = 15$ ---(2) $\times 7$

$56b - 16a = 40$

$56b + 49a = 105$

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$-65a = -65$

$a = \frac{-68^{1}}{-65}$

$\boxed{a = 1}$

Put the value $a = 1$ in eq. (1)

$7b - 2a = 5$

$7b - 2 \times 1 = 5$

$7b - 2 = 5$

$7b = 5 + 2$

$7b = 7$

$b = \frac{7^{1}}{7}$

$\boxed{b = 1}$

But $\frac{1}{x} = a$

$\frac{1}{x} \times \frac{1}{1}$

$1x = 1 \times 1$

$\boxed{x = 1}$

$\frac{1}{y} = b$

$\frac{1}{y} \times \frac{1}{1}$

$1y = 1 \times 1$

$\boxed{y = 1}$

(vi.) $6x + 3y = 6xy$ and $2x + 4y = 5xy$

Ans:- $\frac{6x}{xy} + \frac{3y}{xy} = \frac{6xy}{xy}$ and $\frac{2x}{xy} + \frac{4y}{xy} = \frac{5xy}{xy}$

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$\frac{6}{y} + \frac{3}{x} = 6$ and $\frac{2}{y} + \frac{4}{x} = 5$

Put $\frac{1}{x} = a$ and $\frac{1}{y} = b$

$6b + 3a = 6$ and $2b + 4a = 5$

$3 \div (6b + 3a = 6)$

$2b + 1a = 2$ ---(1)

$2b + 4a = 5$ ---(2)

$2b + 4a = 5$

$2b + 1a = 2$

$+3a = 3$

$a = \frac{3}{3}1$

$\boxed{a = 1}$

Put $a = 1$ in eq. (1)

$2b + 1 \times 1 = 2$

$2b + 1 = 2$

$2b = 2 - 1$

$2b = 1$

$\boxed{b = \frac{1}{2}}$

but $\frac{1}{x} = a$, $\frac{1}{y} = b$

$\frac{1}{x} = 1$ | $\frac{1}{y} = \frac{1}{2}$

$\boxed{x = 1}$ | $\boxed{y = 2}$

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(vii) $\frac{10}{x+y} + \frac{2}{x-y} = 4$ and $\frac{15}{x+y} - \frac{5}{x-y} = -2$

Sol: Put $\frac{1}{x+y} = a$ and $\frac{1}{x-y} = b$

$10a + 2b = 4 \quad \ldots (1)$

$15a - 5b = -2 \quad \ldots (2)$

Multiply eq. (1) by 5 and eq. (2) by 2

$50a + 10b = 20$ and $30a + 10b = -4$

$50a + 10b = 20$

$30a + 10b = -4$

$(-) \quad (-) \quad (+)$

$20a = 16$

$a = \frac{16}{20} \quad \frac{1}{5}$

$\boxed{a = \frac{1}{5}}$

Put $a = \frac{1}{5}$ in (1)

$10 \times \frac{1}{5} + 2b = 4$

$2 + 2b = 4$

$2b = 4 - 2$

$2b = 2$

$b = \frac{2}{2} \quad 1$

$\boxed{b = 1}$

but $\frac{1}{x+y} = a$

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$\frac{1}{x+y} = \frac{1}{5}$

$x+y = 5 \quad ---(3)$

$\frac{1}{x-y} = b$

$\frac{1}{x-y} = 1$

Also,

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

$1x + y = 5$

$1x - y = 1$

$2x = 6$

$x = \frac{6}{2}3$

$\boxed{x = 3}$

$1x + y = 5$

$3 + y = 5$

$y = 5-3$

$\boxed{y = 2}$

(vii) $\frac{1}{3x+y} + \frac{1}{3x-y} = \frac{3}{4}$ and $\frac{1}{2(3x+y)} - \frac{1}{2(3x-y)} = \frac{-1}{8}$

Ans: Put $\frac{1}{3x+y} = a$ and $\frac{1}{3x-y} = b$

$1a + 1b = \frac{3}{4}$ and $\frac{a}{2} - \frac{b}{2} = \frac{-1}{8}$

$4a + 4b = 3$ and $\frac{4a-4b}{8} = \frac{-1}{8}$

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$4a + 4b = 3$ and $4a - 4b = -\frac{1}{8} \times 8$

$4a + 4b = 3$ --- (1) and $4a - 4b = -1$ --- (2)

$4a + 4b = 3$

$4a - 4b = -1$

$8a = 2$

$a = \frac{2}{8}^{1}$

$\times 4$

$\boxed{a = \frac{1}{4}}$

Put $a = \frac{1}{4}$ in (1)

$4 \times \frac{1}{4} + 4b = 3$

$1 + 4b = 3$

$4b = 3 - 1$

$4b = 2$

$b = \frac{2}{4}^{1}_{2}$

$\boxed{b = \frac{1}{2}}$

but $\frac{1}{3x+y} = a$ | $\frac{1}{3x-y} = b$

$\frac{1}{3x+y} = \frac{1}{4}$ | $\frac{1}{3x-y} = \frac{1}{2}$

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

Now

$3x + y = 4$

$3x - y = 2$

$6x = 6$

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$x = \frac{6}{6}$

$x = 1$

Put $x = 1$ in eq. (2)

$3x + y = 4$

$3 \times 1 + y = 4$

$3 + y = 4$

$y = 4 - 3$

$y = 1$

Ques (2) Formulate the following problems as a pair of equations and hence find their solutions:

(i) Ritu can row downstream 20 km in 2 hours and upstream 4 km in 2 Hours. Find her speed of rowing in still water and the speed of the current.

Ans Let speed of current = x km/hour
and speed of Ritu in still water = y km/hour

In case of downstream
speed of Ritu = $(x+y)$ km/hour
Distance covered by Ritu in 2 hours = 20 km

$2(x+y) = 20$ [$\because$ Distance = speed × time]

$x + y = \frac{20}{2}$

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

In case of upstream,
speed of Ritu = $(x-y)$ km/hour

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Distance covered by Ritu in 2 hours = 4 km

$2(x-y) = 4$ [$\because$ Distance = speed × time]

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

$x - y = 2 \quad \ldots\ldots (2)$

Adding equations (1) and (2), we get

$x + y + x - y = 10 + 2$

$2x = 12$

$x = \frac{12}{2}$

$x = 6$

Put the value of x in eq. (1), we get

$6 + y = 10$

$y = 10 - 6$

$y = 4$

Hence, speed of current = x km/hour = 6 km/h and the speed of Ritu = 4 km/hour = 4 km/hour

(iii.) 2 women and 5 men can together finish an embroidery work in 4 days, while 3 women & 6 men can finish it in 3 days. Find the time taken by 1 women alone to finish the work and also that taken by 1 man alone.

Ans:- Let the time taken by 1 women alone to finish an embroidery work = x days

and the time taken by 1 men alone to finish an embroidery work = y days

Since, 2 women and 5 men can together finish

embroidery work in 4 days

$$\frac{4}{x} + \frac{5}{y} = \frac{1}{4} \quad \text{---- (1)}$$

Also 3 women and 6 men can finish an embroidery work in 3 days

$$\frac{3}{x} + \frac{6}{y} = \frac{1}{3}$$

$$3\left(\frac{1}{x} + \frac{2}{y}\right) = \frac{1}{3}$$

$$\frac{1}{3x} + \frac{2}{y} = \frac{1}{3} \times \frac{1}{3}$$

$$\frac{1}{x} + \frac{2}{y} = \frac{1}{9} \quad \text{---- (2)}$$

Let $\frac{1}{x} = p$ and $\frac{1}{y} = q$, then equation (1) and (2) become

$$4p + 5p = \frac{1}{4} \quad \text{---- (3)}$$

$$p + 2q = \frac{1}{9} \quad \text{---- (4)}$$

Eq. (3) and (4) can be rewritten as,

$$8p + 20q = 1 \quad \text{---(5)}$$

$$9p + 18q = 1 \quad \text{---(6)}$$

Multiplying eq. (5) by 9 and eq. (6) by 8, we get

$$72p + 180q = 9 \quad \text{---- (7)}$$

$$72p + 144q = 8 \quad \text{---(8)}$$

Subtracting eq. (8) from eq. (7), we get

$$(72p + 180q) - (72p + 144q) = 9 - 8$$

$$72p + 180q - 72p - 144q = 1$$

$$36q = 1$$

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$q = \frac{1}{36}$

Put the value of q in equation (7), we get

$72p + \frac{5}{36} \times \frac{1}{36} = 9$

$72p + 5 = 9$

$72p = 9 - 5$

$72p = 4$

$p = \frac{4}{72} \frac{1}{18}$

$p = \frac{1}{18}$

$\frac{1}{x} = p$	$\frac{1}{y} = q$
$\frac{1}{x} = \frac{1}{18}$	$\frac{1}{y} = \frac{1}{36}$
$x = 18$	$y = 36$

(iii) Roohi travels 300 km to her home partly by train and partly by bus. She takes 4 hours if she travels 60 km by train and the remaining by bus. If she travels 100 km by train and the remaining by bus, she takes 10 minutes longer. Find the speed of train and the bus separately.

Ans:- Let the speed of train = x km/hour and the speed of bus = y km/hour

Total distance travelled by Roohi = 300 km

If she travels 60 km by train, then distance travelled by bus = 300 − 60 = 240 km

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Time taken to travel 60 km by train $= \frac{60}{x}$
and the time taken to travel 240 km by bus $= \frac{240}{y}$

total time = 4 hours

$$\frac{60}{x} + \frac{240}{y} = 4$$

$$4\left(\frac{15}{x} + \frac{60}{y}\right) = 4$$

$$\frac{15}{x} + \frac{60}{y} = \frac{4}{4}$$

$$\frac{15}{x} + \frac{60}{y} = 1 \quad \text{----(1)}$$

Again, if she travels 100 km by train, then distance travelled by bus = 300 − 100
= 200 km

Now, time taken to travel 100 km by train $= \frac{100}{x}$
and time taken to travel 200 km by bus $= \frac{200}{y}$

Total time = 4 hours 10 min

$$\frac{100}{x} + \frac{200}{y} = 4 \text{ hours} + \frac{10}{60} \text{ hours}$$

$$100\left(\frac{1}{x} + \frac{2}{y}\right) = \left(4 + \frac{1}{6}\right) \text{hours}$$

$$100\left(\frac{1}{x} + \frac{2}{y}\right) = \frac{24+1}{6}$$

$$\frac{1}{x} + \frac{2}{y} = \frac{25}{6} \times \frac{1}{100_4}$$

$$\frac{1}{x} + \frac{2}{y} = \frac{1}{6 \times 4}$$

$$\frac{1}{x} + \frac{2}{y} = \frac{1}{24} \quad \text{----(2)}$$

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Let $\frac{1}{x} = p$ and $\frac{1}{y} = q$, then eq. (1) and (2) become

$$15p + 60q = 1 \quad \text{---(3)}$$

$$p + 2q = \frac{1}{24}$$

$$24p + 48q = 1 \quad \text{---(4)}$$

Multiplying eq. (3) by 24 and eq. (4) by 15, we get

$$360p + 1440q = 24 \quad \text{---(5)}$$

$$360p + 720q = 15 \quad \text{---(6)}$$

Subtracting eq. (6) from eq. (5), we get

$$360p + 1440p - (360p + 720q) = 24 - 15$$

$$360p + 1440q - 360p - 720q = 9$$

$$720q = 9$$

$$q = \frac{9}{720} = \frac{1}{80}$$

Put the value of q in eq. (3), we get

$$15p + 60 \times \frac{1}{80} = 1$$

$$15p + \frac{3}{4} = 1$$

$$15p = 1 - \frac{3}{4}$$

$$15p = \frac{4-3}{4}$$

$$15p = \frac{1}{4}$$

$$p = \frac{1}{4} \times \frac{1}{15}$$

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$p = \frac{1}{60}$

$\frac{1}{x} = p$	$\frac{1}{y} = q$
$\frac{1}{x} = \frac{1}{60}$	$\frac{1}{y} = \frac{1}{80}$
$x = 60$	$y = 80$

Hence speed of train = x km/hour = 60 km/hour
and speed of bus = y km/hour = 80 km/hour Ans

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