

CBSE Class-10 Mathematics

NCERT solution

Chapter - 3

Pair of Linear Equations in Two Variables - Exercise 3.6

1. Solve the following pairs of equations by reducing them to a pair of linear equations:

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

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

(ii)  $\frac{2}{\sqrt{x}} + \frac{3}{\sqrt{y}} = 2$

$$\frac{4}{\sqrt{x}} - \frac{9}{\sqrt{y}} = -1$$

(iii)  $\frac{4}{x} + 3y = 14$

$$\frac{3}{x} - 4y = 23$$

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

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

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

$$\frac{8x+7y}{xy} = 15$$

(vi)  $6x + 3y = 6xy$

$2x + 4y = 5xy$

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

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

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

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

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

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

Let  $\frac{1}{x} = p$  and  $\frac{1}{y} = q$

Putting this in equation (1) and (2), we get

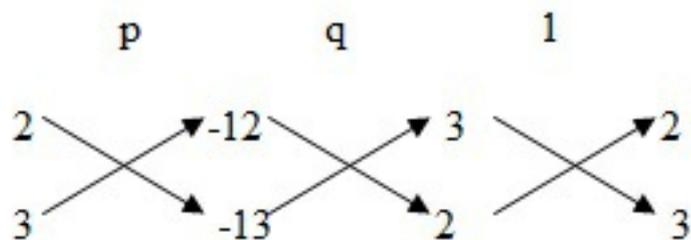
$\frac{p}{2} + \frac{q}{3} = 2$  and  $\frac{p}{3} + \frac{q}{2} = \frac{13}{6}$

Multiply both equation by 6, we get

$\Rightarrow 3p + 2q = 12$  and  $2p + 3q = 13$

$\Rightarrow 3p + 2q - 12 = 0 \dots\dots\dots (3)$

and  $2p + 3q - 13 = 0 \dots\dots\dots (4)$



$$\frac{p}{2(-13) - 3(-12)} = \frac{q}{(-12)2 - (-13)3} = \frac{1}{3 \times 3 - 2 \times 2}$$

$$\Rightarrow \frac{p}{-26 + 36} = \frac{q}{-24 + 39} = \frac{1}{9 - 4}$$

$$\Rightarrow \frac{p}{10} = \frac{q}{15} = \frac{1}{5}$$

$$\Rightarrow \frac{p}{10} = \frac{1}{5} \text{ and } \frac{q}{15} = \frac{1}{5}$$

$$\Rightarrow p = 2 \text{ and } q = 3$$

But  $\frac{1}{x} = p$  and  $\frac{1}{y} = q$

Putting value of p and q in this we get

$$x = \frac{1}{2} \text{ and } y = \frac{1}{3}$$

$$\text{(ii) } \frac{2}{\sqrt{x}} + \frac{3}{\sqrt{y}} = 2 \dots (1)$$

$$\frac{4}{\sqrt{x}} - \frac{9}{\sqrt{y}} = -1 \dots (2)$$

Let  $\frac{1}{\sqrt{x}} = p$  and  $\frac{1}{\sqrt{y}} = q$

Putting this in (1) and (2), we get

$$2p + 3q = 2 \dots (3)$$

$$4p - 9q = -1 \dots (4)$$

Multiplying (3) by 2 and subtracting it from (4), we get

$$\Rightarrow 4p - 9q - 2(2p + 3q) = -1 - 2(2)$$

$$\Rightarrow 4p - 9q - 4p - 6q = -1 - 4$$

$$\Rightarrow -15q = -5$$

$$\Rightarrow q = \frac{-5}{-15} = \frac{1}{3}$$

Putting value of q in (3), we get

$$\Rightarrow 2p + 1 = 2$$

$$\Rightarrow 2p = 1$$

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

Putting values of p and q in ( $\frac{1}{\sqrt{x}} = p$  and  $\frac{1}{\sqrt{y}} = q$ ), we get

$$\frac{1}{\sqrt{x}} = \frac{1}{2} \text{ and } \frac{1}{\sqrt{y}} = \frac{1}{3}$$

$$\Rightarrow \frac{1}{x} = \frac{1}{4} \text{ and } \frac{1}{y} = \frac{1}{9}$$

$$\Rightarrow x = 4 \text{ and } y = 9$$

$$\text{(iii) } \frac{4}{x} + 3y = 14 \dots (1)$$

$$\frac{3}{x} - 4y = 23 \dots (2)$$

Let  $\frac{1}{x} = p$

we get

$$4p + 3y = 14 \dots (3)$$

$$3p - 4y = 23 \dots (4)$$

Multiplying (3) by 3 and (4) by 4, we get

$$3(4p + 3y - 14 = 0) \text{ and, } 4(3p - 4y - 23 = 0)$$

$$\Rightarrow 12p + 9y - 42 = 0 \dots (6) \quad 12p - 16y - 92 = 0 \dots (7)$$

Subtracting (7) from (6), we get

$$9y - (-16y) - 42 - (-92) = 0$$

$$\Rightarrow 25y + 50 = 0$$

$$\Rightarrow y = \frac{-50}{25} = -2$$

Putting value of y in (4), we get

$$4p + 3(-2) = 14$$

$$\Rightarrow 4p - 6 = 14$$

$$\Rightarrow 4p = 20$$

$$\Rightarrow p = 5$$

Putting value of p in (3), we get

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

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

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

$$\text{(iv) } \frac{5}{x-1} + \frac{1}{y-2} = 2 \dots (1)$$

$$\frac{6}{x-1} - \frac{3}{y-2} = 1 \dots (2)$$

$$\text{Let } \frac{1}{x-1} = p \text{ and } \frac{1}{y-2} = q$$

Putting this in (1) and (2), we get

$$5p + q = 2$$

$$\Rightarrow 5p + q - 2 = 0 \dots (3)$$

$$\text{And, } 6p - 3q = 1$$

$$\Rightarrow 6p - 3q - 1 = 0 \dots (4)$$

Multiplying (3) by 3 and adding it to (4), we get

$$3(5p + q - 2) + 6p - 3q - 1 = 0$$

$$\Rightarrow 15p + 3q - 6 + 6p - 3q - 1 = 0$$

$$\Rightarrow 21p - 7 = 0$$

$$\Rightarrow p = \frac{1}{3}$$

Putting this in (3), we get

$$5\left(\frac{1}{3}\right) + q - 2 = 0$$

$$\Rightarrow 5 + 3q = 6$$

$$\Rightarrow 3q = 6 - 5 = 1$$

$$\Rightarrow q = \frac{1}{3}$$

Putting values of p and q in ( $\frac{1}{x-1} = p$  and  $\frac{1}{y-2} = q$ ), we get

$$\frac{1}{x-1} = \frac{1}{3} \text{ and } \frac{1}{y-2} = \frac{1}{3}$$

$$\Rightarrow 3 = x - 1 \text{ and } 3 = y - 2$$

$$\Rightarrow x = 4 \text{ and } y = 5$$

$$\text{(v) } 7x - 2y = 5xy \dots (1)$$

$$8x + 7y = 15xy \dots (2)$$

Dividing both the equations by xy, we get

$$\frac{7}{y} - \frac{2}{x} = 5 \dots (3)$$

$$\frac{8}{y} + \frac{7}{x} = 15 \dots (4)$$

$$\text{Let } \frac{1}{x} = p \text{ and } \frac{1}{y} = q$$

Putting these in (3) and (4), we get

$$7q - 2p = 5 \dots (5)$$

$$8q + 7p = 15 \dots (6)$$

From equation (5),

$$2p = 7q - 5$$

$$\Rightarrow p = \frac{7q - 5}{2}$$

Putting value of p in (6), we get

$$8q + 7 \left( \frac{7q - 5}{2} \right) = 15$$

$$\Rightarrow 16q + 49q - 35 = 30$$

$$\Rightarrow 65q = 30 + 35 = 65$$

$$\Rightarrow q = 1$$

Putting value of q in (5), we get

$$7(1) - 2p = 5$$

$$\Rightarrow 2p = 2$$

$$\Rightarrow p = 1$$

Putting value of p and q in  $\left( \frac{1}{x} = p \text{ and } \frac{1}{y} = q \right)$ , we get  $x = 1$  and  $y = 1$

$$\text{(vi) } 6x + 3y - 6xy = 0 \dots (1)$$

$$2x + 4y - 5xy = 0 \dots (2)$$

Dividing both the equations by xy, we get

$$\frac{6}{y} + \frac{3}{x} - 6 = 0 \dots (3)$$

$$\frac{2}{y} + \frac{4}{x} - 5 = 0 \dots (4)$$

$$\text{Let } \frac{1}{x} = p \text{ and } \frac{1}{y} = q$$

Putting these in (3) and (4), we get

$$6q + 3p - 6 = 0 \dots (5)$$

$$2q + 4p - 5 = 0 \dots (6)$$

From (5),

$$3p = 6 - 6q$$

$$\Rightarrow p = 2 - 2q$$

Putting this in (6), we get

$$2q + 4(2 - 2q) - 5 = 0$$

$$\Rightarrow 2q + 8 - 8q - 5 = 0$$

$$\Rightarrow -6q = -3 \Rightarrow q = \frac{1}{2}$$

Putting value of q in  $(p = 2 - 2q)$ , we get

$$p = 2 - 2\left(\frac{1}{2}\right) = 2 - 1 = 1$$

Putting values of p and q in  $\left(\frac{1}{x} = p \text{ and } \frac{1}{y} = q\right)$ , we get  $x = 1$  and  $y = 2$

$$\text{(vii) } \frac{10}{x+y} + \frac{2}{x-y} = 4 \dots (1)$$

$$\frac{15}{x+y} - \frac{5}{x-y} = -2 \dots (2)$$

$$\text{Let } \frac{1}{x+y} = p \text{ and } \frac{1}{x-y} = q$$

Putting this in (1) and (2), we get

$$10p + 2q = 4 \dots (3)$$

$$15p - 5q = -2 \dots (4)$$

From equation (3),

$$2q = 4 - 10p$$

$$\Rightarrow q = 2 - 5p \dots (5)$$

Putting this in (4), we get

$$15p - 5(2 - 5p) = -2$$

$$\Rightarrow 15p - 10 + 25p = -2$$

$$\Rightarrow 40p = 8 \Rightarrow p = \frac{1}{5}$$

Putting value of p in (5), we get

$$q = 2 - 5\left(\frac{1}{5}\right) = 2 - 1 = 1$$

Putting values of p and q in  $\left(\frac{1}{x+y} = p \text{ and } \frac{1}{x-y} = q\right)$ , we get

$$\frac{1}{x+y} = \frac{1}{5} \text{ and } \frac{1}{x-y} = \frac{1}{1}$$

$$\Rightarrow x + y = 5 \dots (6) \text{ and } x - y = 1 \dots (7)$$

Adding (6) and (7), we get

$$2x = 6 \Rightarrow x = 3$$

Putting  $x = 3$  in (7), we get

$$3 - y = 1$$

$$\Rightarrow y = 3 - 1 = 2$$

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

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

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

$$\text{Let } \frac{1}{3x+y} = p \text{ and } \frac{1}{3x-y} = q$$

Putting this in (1) and (2), we get

$$p + q = \frac{3}{4} \text{ and } \frac{p}{2} - \frac{q}{2} = -\frac{1}{8}$$

$$\Rightarrow 4p + 4q = 3 \dots (3) \text{ and } 4p - 4q = -1 \dots (4)$$

Adding (3) and (4), we get

$$8p = 2 \Rightarrow p = \frac{1}{4}$$

Putting value of  $p$  in (3), we get

$$4 \left(\frac{1}{4}\right) + 4q = 3$$

$$\Rightarrow 1 + 4q = 3$$

$$\Rightarrow 4q = 3 - 1 = 2$$

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

Putting value of  $p$  and  $q$  in  $\frac{1}{3x+y} = p$  and  $\frac{1}{3x-y} = q$ , we get

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

$$\Rightarrow 3x + y = 4 \dots (5) \text{ and } 3x - y = 2 \dots (6)$$

Adding (5) and (6), we get

$$6x = 6 \Rightarrow x = 1$$

Putting  $x = 1$  in (5), we get

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

$$\Rightarrow y = 4 - 3 = 1$$

Therefore,  $x = 1$  and  $y = 1$

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**2. Formulate the following problems as a part 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.**

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

**(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 the train and the bus separately.**

**Ans. (i)** Let speed of rowing in still water =  $x$  km/h

Let speed of current =  $y$  km/h

So, speed of rowing downstream =  $(x + y)$  km/h

And, speed of rowing upstream =  $(x - y)$  km/h

According to given conditions,

$$\frac{20}{x+y} = 2 \text{ and } \frac{4}{x-y} = 2$$

$$\Rightarrow 2x + 2y = 20 \text{ and } 2x - 2y = 4$$

$$\Rightarrow x + y = 10 \dots (1) \text{ and } x - y = 2 \dots (2)$$

Adding (1) and (2), we get

$$2x = 12$$

$$\Rightarrow x = 6$$

Putting  $x = 6$  in (1), we get

$$6 + y = 10$$

$$\Rightarrow y = 10 - 6 = 4$$

Therefore, speed of rowing in still water = 6 km/h

Speed of current = 4 km/h

**(ii)** Let time taken by 1 woman alone to finish the work =  $x$  days

Let time taken by 1 man alone to finish the work =  $y$  days

So, 1 woman's 1-day work =  $(\frac{1}{x})$ th part of the work

And, 1 man's 1-day work =  $(\frac{1}{y})$ th part of the work

So, 2 women's 1-day work =  $(\frac{2}{x})$ th part of the work

And, 5 men's 1-day work =  $(\frac{5}{y})$ th part of the work

Therefore, 2 women and 5 men's 1-day work =  $(\frac{2}{x} + \frac{5}{y})$ th part of the work... (1)

It is given that 2 women and 5 men complete work in = 4 days

It means that in 1 day, they will be completing  $\frac{1}{4}$ th part of the work ... (2)

Clearly, we can see that (1) = (2)

$$\Rightarrow \frac{2}{x} + \frac{5}{y} = \frac{1}{4} \dots (3)$$

Similarly,  $\frac{3}{x} + \frac{6}{y} = \frac{1}{3} \dots (4)$

Let  $\frac{1}{x} = p$  and  $\frac{1}{y} = q$

Putting this in (3) and (4), we get

$$2p + 5q = \frac{1}{4} \text{ and } 3p + 6q = \frac{1}{3}$$

$$\Rightarrow 8p + 20q = 1 \dots (5) \text{ and } 9p + 18q = 1 \dots (6)$$

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

$$72p + 180q = 9 \dots (7)$$

$$72p + 144q = 8 \dots (8)$$

Subtracting (8) from (7), we get

$$36q = 1$$

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

Putting this in (6), we get

$$9p + 18\left(\frac{1}{36}\right) = 1$$

$$\Rightarrow 9p = \frac{1}{2}$$

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

Putting values of p and q in  $\frac{1}{x} = p$  and  $\frac{1}{y} = q$ , we get  $x = 18$  and  $y = 36$

Therefore, 1 woman completes work in = 18 days

And, 1 man completes work in = 36 days

**(iii)** Let speed of train =  $x$  km/h and let speed of bus =  $y$  km/h

According to given conditions,

$$\frac{60}{x} + \frac{240}{y} = 4 \text{ and } \frac{100}{x} + \frac{200}{y} = 4 + \frac{10}{60}$$

$$\text{Let } \frac{1}{x} = p \text{ and } \frac{1}{y} = q$$

Putting this in the above equations, we get

$$60p + 240q = 4 \dots (1)$$

$$\text{And } 100p + 200q = \frac{25}{6} \dots (2)$$

Multiplying (1) by 5 and (2) by 3, we get

$$300p + 1200q = 20 \dots (3)$$

$$300p + 600q = \frac{25}{2} \dots (4)$$

Subtracting (4) from (3), we get

$$600q = 20 - \frac{25}{2} = 7.5$$

$$\Rightarrow q = \frac{7.5}{600}$$

Putting value of  $q$  in (2), we get

$$100p + 200 \left( \frac{7.5}{600} \right) = \frac{25}{6}$$

$$\Rightarrow 100p + 2.5 = \frac{25}{6}$$

$$\Rightarrow 100p = \frac{25}{6} - 2.5$$

$$\Rightarrow p = \frac{10}{600}$$

But  $\frac{1}{x} = p$  and  $\frac{1}{y} = q$

Therefore,  $x = \frac{600}{10} = 60$  km/h and  $y = \frac{600}{7.5} = 80$  km/h

Therefore, speed of train = 60 km/h

And, speed of bus = 80 km/h