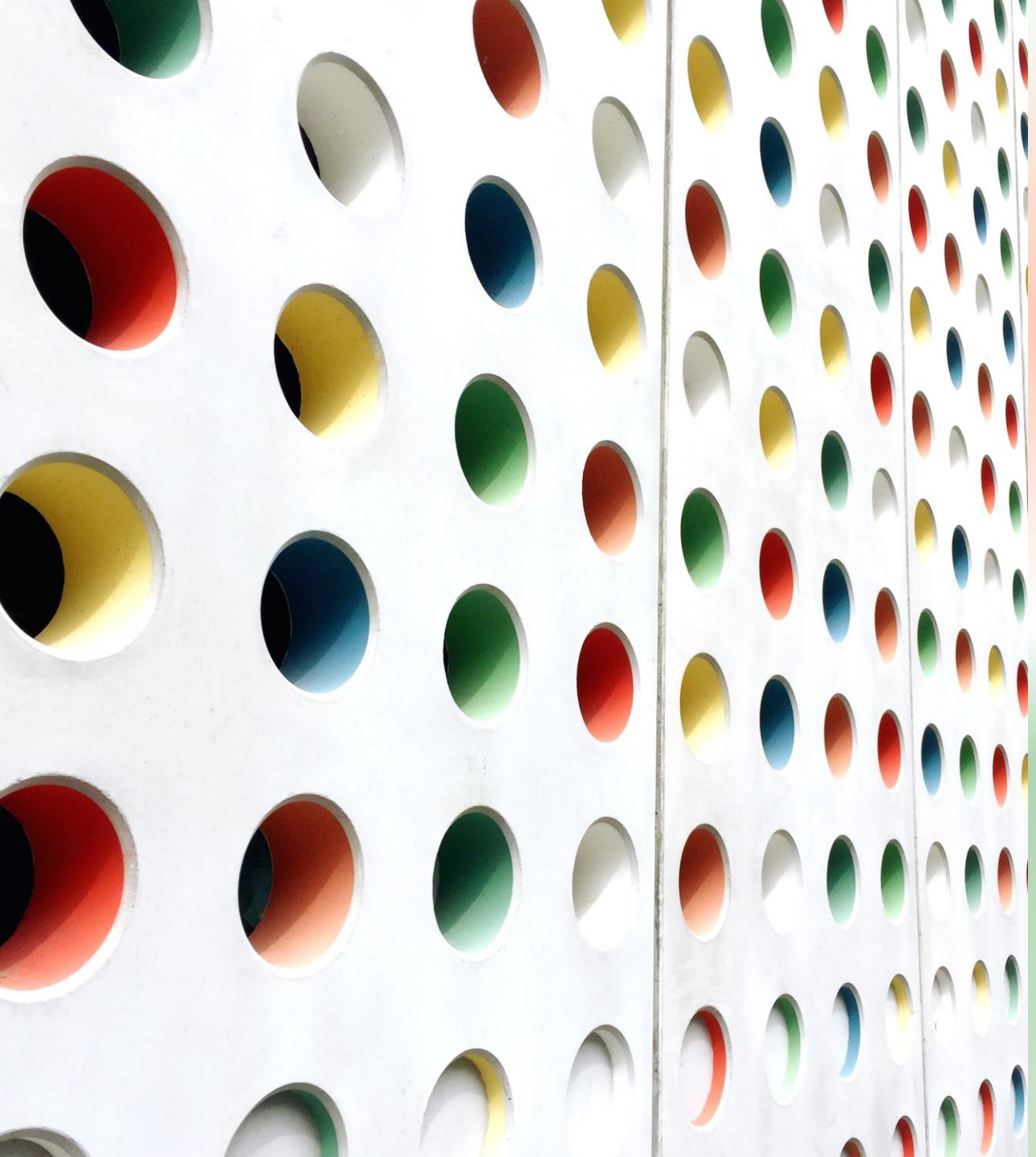

PAIR OF LINEAR EQUATIONS.

Equations Reducible to a Pair of Linear Equations in Two Variables.

Chapter: 3, Exercise: 3.5,3.6

NITISH KUMAR

For which values of a and b does the following pair of linear equations have an infinite number of solutions?

$2x + 3y = 7$

$(a - b)x + (a + b)y = 3a + b - 2$

$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ — (I)

$a_1 = 2,\ b_1 = 3,\ c_1 = 7$

$a_2 = (a-b),\ b_2 = (a+b)$

$c_2 = 3a + b - 2$

$$\frac{2}{a-b} = \frac{3}{a+b} = \frac{7}{3a+b-2}$$

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

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

$2a + 2b = 3a - 3b$

$2a - 3a = -3b - 2b$

$-a = -5b$

$a = 5b$ — (II)

$\frac{3}{a+b} \times \frac{7}{3a+b-2}$

$3(3a+b-2) = 7(a+b)$

$9a + 3b - 6 = 7a + 7b$

$9a - 7a + 3b - 7b - 6 = 0$

$2a - 4b - 6 = 0$

$2(5b) - 4b - 6 = 0$

$10b - 4b - 6 = 0$

$6b = 6$

$b = \frac{6}{6} = 1 \Rightarrow b = 1$

Put $b = 1$ in (II)

$a = 5$

For which value of k will the following pair of linear equations have no solution?

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

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

$a_2 = 2k - 1,\ b_2 = k - 1$

$c_2 = 2k + 1$

$\left[\frac{3}{2k-1} = \frac{1}{k-1}\right] \neq \frac{1}{2k+1}$

$3(k-1) = 1(2k-1)$

$3k - 3 = 2k - 1$

$3k - 2k = -1 + 3$

$\boxed{k = 2}$

$(4-1)x + (2-1)y = 4+1$

$3x + y = 5$

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

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

$\frac{1}{5}$

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

$$\frac{1}{2x}+\frac{1}{3y}=2 \quad \text{— (I)} \qquad \frac{1}{3x}+\frac{1}{2y}=\frac{13}{6} \quad \text{— (II)}$$

Let $\frac{1}{x}=u$, $\frac{1}{y}=v$ — (A)

$\frac{u}{2}+\frac{v}{3}=2$ | $\frac{u}{3}+\frac{v}{2}=\frac{13}{6}$

$\frac{3u+2v}{6}=2$ | $\frac{2u+3v}{6}=\frac{13}{6}$

$3u+2v=12$ — (III) | $2u+3v=13$ — (IV)

multiplying (III) by 2 and (IV) by 3

and Sub.

$6u+4v=24$

$6u+9v=39$

$-5v=-15$

$v=\frac{-15}{-5}=3$

$v=3$ ✓

Put the value $v=3$ in (III)

$3u+2(3)=12$

$3u+6=12$

$3u=12-6$

$3u=6$

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

$u=2$ ✓

from equation (A)

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

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

$\frac{1}{2(\frac{1}{2})}+\frac{1}{3(\frac{1}{3})}=2 \Rightarrow$

$1+1=2$

$2=2$.

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

$$\frac{4}{x} + 3y = 14 \quad (I) \qquad \frac{3}{x} - 4y = 23 \quad (II)$$

Let $\frac{1}{x} = u$ — (A)

$4u + 3y = 14$ — (III)

$3u - 4y = 23$ — (IV)

multiplying (III) by (4) and (IV) by (3) and add

$16u + 12y = 56$

$9u - 12y = 69$

$25u = 125$

$u = \frac{125}{25} = 5 \quad (u = 5)$

Put the value of $(u = 5)$ in equation (III)

$4(5) + 3y = 14$

$20 + 3y = 14$

$3y = 14 - 20$

$3y = -6$

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

$y = -2$

from equation (A)

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

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

$\frac{4}{\frac{1}{5}} + 3(-2) = 14$

$4 \times 5 + (-6) = 14$

$20 - 6 = 14$

$14 = 14$ ✓

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

$$\frac{5}{x-1}+\frac{1}{y-2}=2 \quad -(I) \qquad \frac{6}{x-1}-\frac{3}{y-2}=1 \quad -(II)$$

Let $\frac{1}{x-1}=u$ ... (A)

$\frac{1}{y-2}=v$ ... (A)

$5u+v=2$ ... (III)

$6u-3v=1$ ... (IV)

multiplying equation (III) by (3) and adding subsequent

$15u+3v=6$

$6u-3v=1$

$21u=7$

$u=\frac{7}{21}$ $\Rightarrow$ $u=\frac{1}{3}$

Using $u=\frac{1}{3}$ in equation (I)

$5\left(\frac{1}{3}\right)+v=2$

$\frac{5}{3}+v=2$

$v=2-\frac{5}{3}$

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

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

From equation (A)

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

$x-1=3$

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

Verify

$\frac{5}{4-1}+\frac{1}{5-2}=2$

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

$\frac{5+1}{3}=2$ ... (I)

$\frac{6}{3}=2$ ... (II)

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

$y-2=3$

$y=3+2$

$y=5$

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

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

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

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

$\frac{8}{y} + \frac{7}{x} = 15$ — (II)

$\frac{7}{y} - \frac{2}{x} = 5$ — (I)

Let $\frac{1}{x} = u$, $\frac{1}{y} = v$ — (A)

$7v - 2u = 5$ — (III)

$8v + 7u = 15$ — (IV)

multiplying (III) by 7 and (IV) by 2

and adding

$49v - 14u = 35$

$16v + 14u = 30$

$65v = 65$

$v = \frac{65}{65}$

$1v = 1$

Using $v = 1$ in (III)

$7 - 2u = 5$

$-2u = 5 - 7$

$-2u = -2$

$1u = 1$

from eqn (A)

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

$1x = 1$

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

$7 - 2 = 5$

$5 = 5$

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

$6x + 3y = 6xy$ $\qquad$ $2x + 4y = 5xy$

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

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

$\frac{6}{y} + \frac{3}{x} = 6$ — (I) $\qquad$ $\frac{2}{y} + \frac{4}{x} = 5$ — (II)

Let $\frac{1}{x} = u$, $\frac{1}{y} = v$ — (A)

$6v + 3u = 6$ — (III)

$2v + 4u = 5$ — (IV)

multiply (IV) by 3 and sub.

$6v + 3u = 6$

$6v + 12u = 15$

$-9u = -9$

$u = \frac{9}{9}$

$\boxed{u = 1}$

Using $(u=1)$ in (III)

$6v + 3 = 6$

$6v = 6 - 3$

$6v = 3$

$v = \frac{3}{6} \Rightarrow \boxed{v = \frac{1}{2}}$

from equation (A)

$\frac{1}{x} = u \Rightarrow \boxed{x = 1}$

$\frac{1}{y} = \frac{1}{2} \Rightarrow \boxed{y = 2}$

$6(1) + 3(2) = 6(1)(2)$

$6 + 6 = 12$

$12 = 12$ ✓

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

$$\frac{1}{3x+y}+\frac{2}{3x-y}=\frac{3}{4} \quad (I) \qquad \frac{1}{2(3x+y)}-\frac{1}{2(3x-y)}=-\frac{1}{8} \quad (II)$$

Let $\frac{1}{3x+y}=u$ — (A)

$\frac{1}{3x-y}=v$

$u+2v=\frac{3}{4}$

$4u+8v=3$ — (III)

$\frac{1}{2}u-\frac{v}{2}=-\frac{1}{8}$

$\frac{u-v}{2}=-\frac{1}{8}$

$u-v=-\frac{2}{8}$

$u-v=-\frac{1}{4}$

$-4(u-v)=1$

$-4u+4v=1$ — (IV)

adding (III) and (IV)

$4u+8v=3$

$-4u+4v=1$

$12v=4$

$v=\frac{4}{12}$

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

put $v=\frac{1}{3}$ in (IV)

$-4u+4(\frac{1}{3})=1$

$-4u+\frac{4}{3}=1$

$-4u=1-\frac{4}{3}$

$-4u=\frac{3-4}{3}$

$+4u=+\frac{1}{3}$

$u=\frac{1}{12}$

from equation A

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

$\frac{1}{3x+y}=\frac{1}{12}$

$3x+y=12$ — (V)

$3x-y=3$ — (VI)

$3x - y = 3$ — (V)

$3x + y = 12$ — (VI)

Adding (V) and (VI)

$$\begin{array}{r} 3x - y = 3 \\ 3x + y = 12 \\ \hline 6x = 15 \end{array}$$

$x = \frac{15}{6} = \frac{5}{2}$

$\boxed{x = \frac{5}{2}}$ ✓

$3x - y = 3$

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

$\frac{15}{2} - y = 3$ ✓

$-y = 3 - \frac{15}{2}$

$-y = \frac{6 - 15}{2}$

$-y = -\frac{9}{2}$

$\boxed{y = \frac{9}{2}}$ ✓

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