CLASS 10ᵀᴴ MID TERM

SCORE BOOSTER

LINEAR EQUATION IN TWO VARIABLES

MATHS

Deeksha Scholastic Aptitude Test

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Linear equations
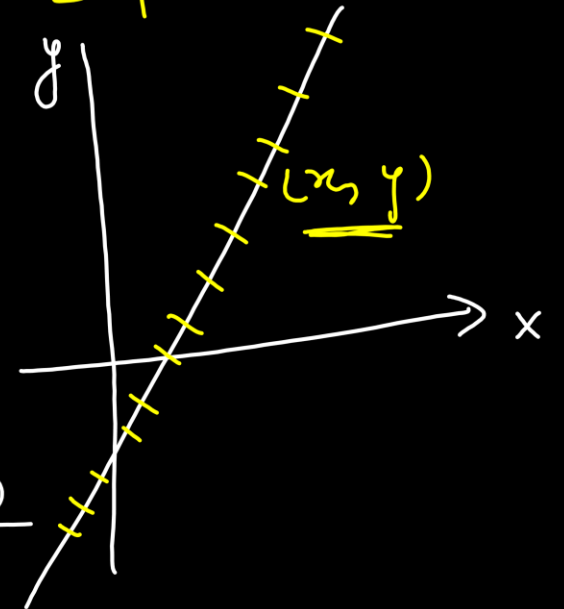
$$x = 1 \qquad\qquad x = 1$$

$$\underline{x} + \underline{y} = \boxed{2}$$

$$\text{LHS} \quad = \quad \text{RHS} \longrightarrow \text{infinite}$$

$$x = ? \quad 1 \qquad\qquad \text{sol}^n.$$

$$y = ? \quad 1$$

$$\boxed{1 + 1 = 2}$$

Sol^n of

$L \cdot E$

$$x = \frac{1}{2} \quad ; \quad y = \frac{3}{2}$$

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

(x, y)

$$x + y + 7 = 0$$

$$3x + y - 7 = 0$$

$$a_1 x + b_1 y + c_1 = 0$$

$$a_2 x + b_2 y + c_2 = 0$$

Methods of solving Linear equations in two variables

1. Graphical method
2. Algebraic method

Graphical method

X + Y = 2
X – Y = 0
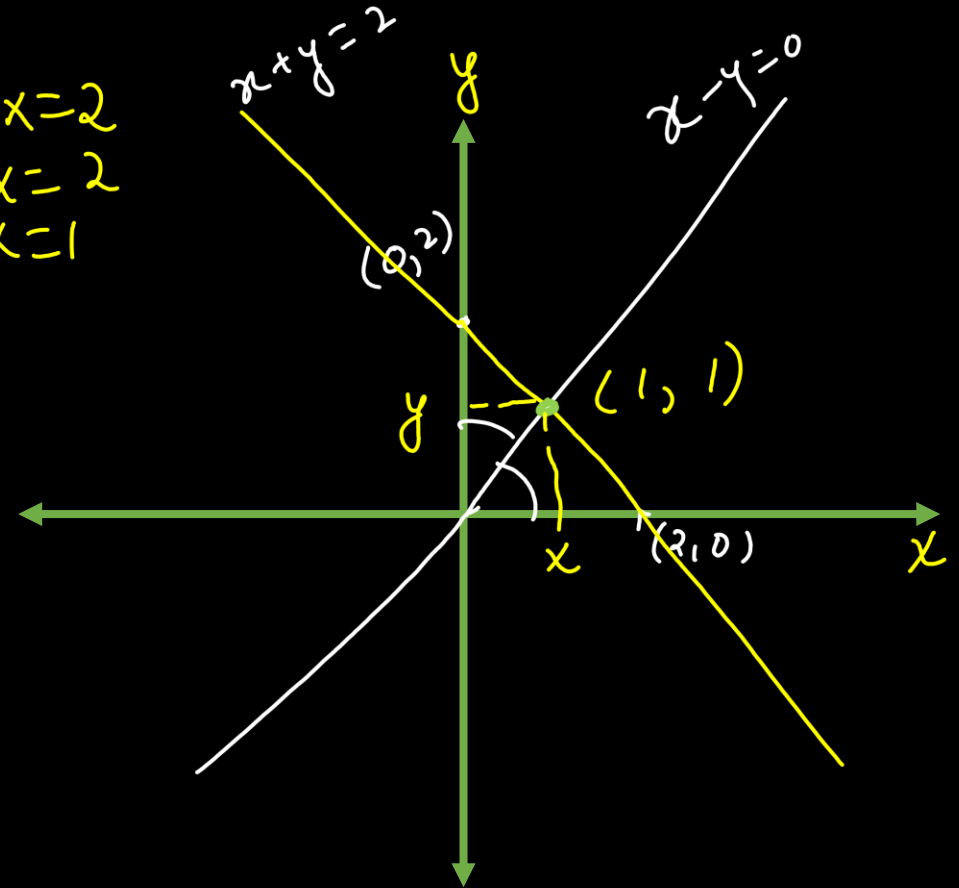
$x + x = 2$
$2x = 2$
$x = 1$

$\boxed{X} + y = 2$

x	0	2
Y	2	0

$x - y = 0$

$y = x$

Solve the following system of linear equations graphically

$X + Y = 6$

$X - Y = 2$

$\left.\begin{array}{c}\\\\\end{array}\right\}$ $\boxed{2x = 8}$

$x = 4$

$x + y = 6$

$x \rightarrow$	0	6
$y \rightarrow$	6	0

$\otimes - y = 2$

$x \rightarrow$	0	2
$y \rightarrow$	-2	0
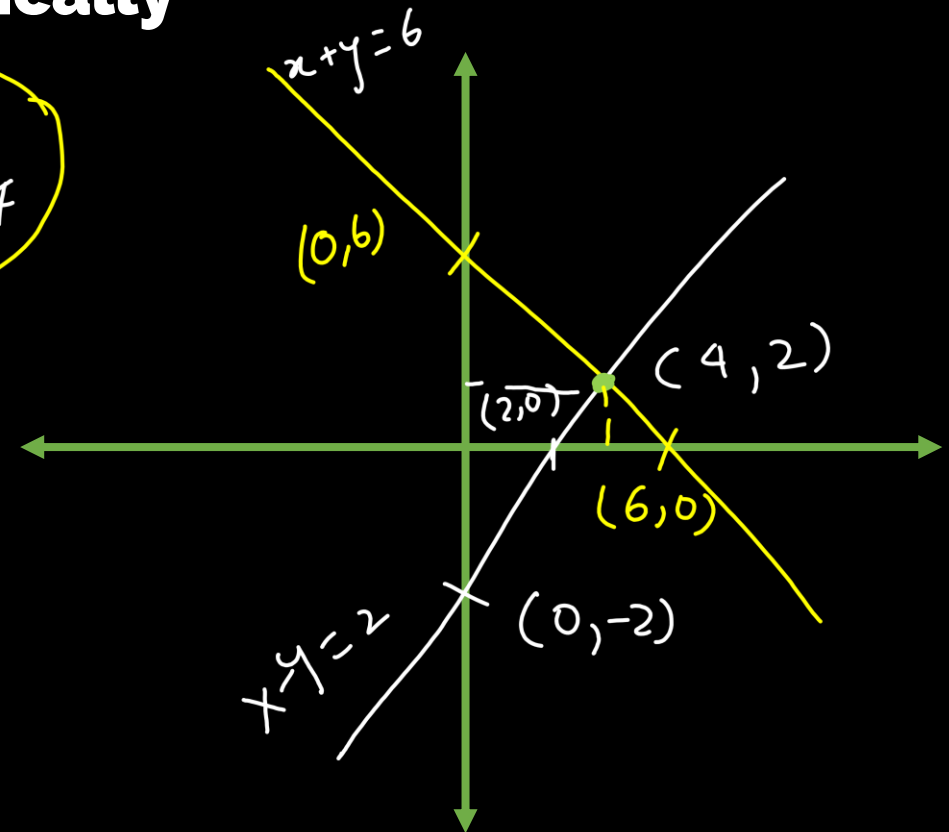
$x + y = 6$

$(0,6)$

$(2,0)$

$(4,2)$

$(6,0)$

$(0,-2)$

$x - y = 2$
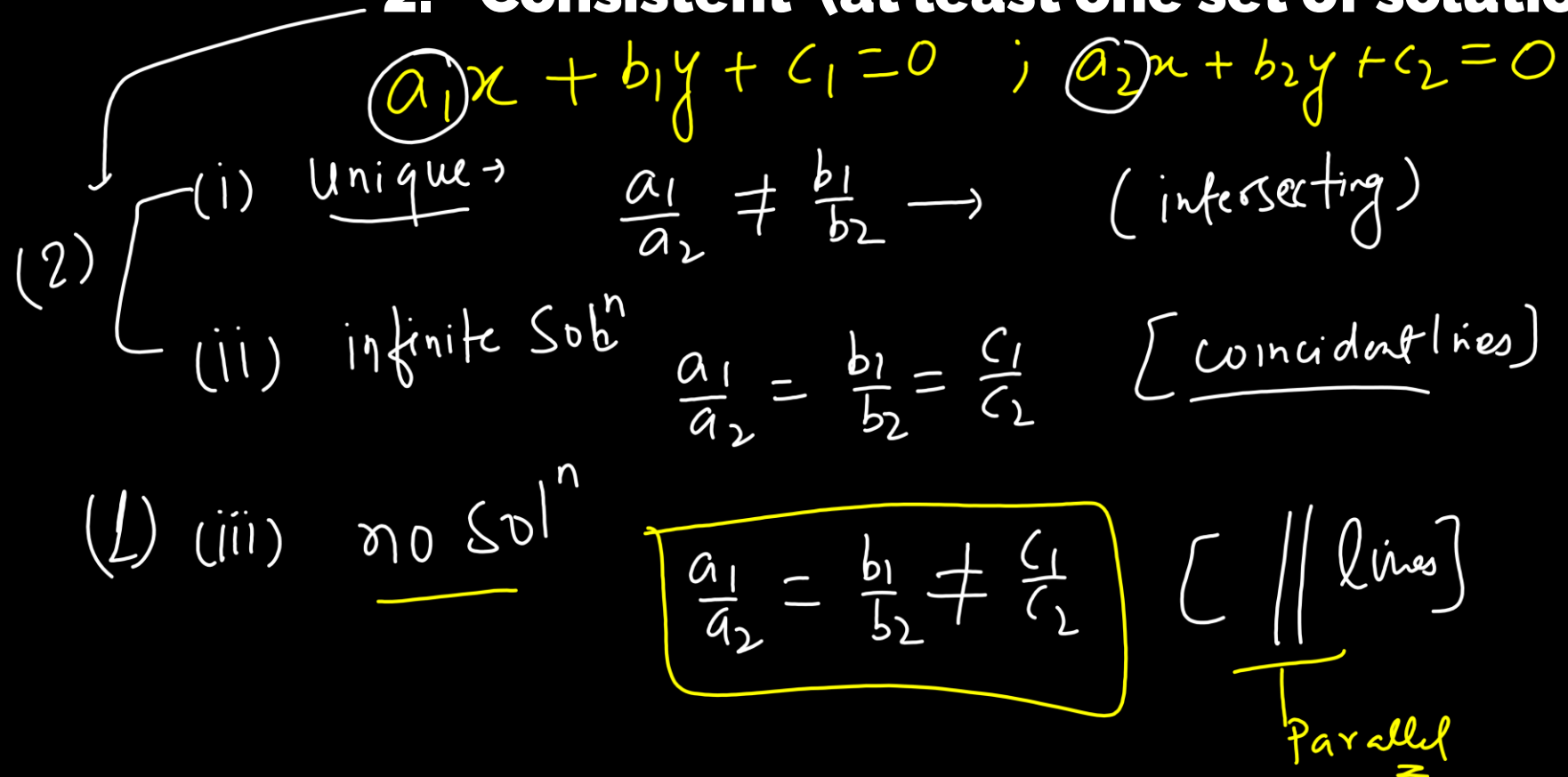
Nature of solutions of linear equations

1. Inconsistent (no solution)
2. Consistent (at least one set of solution)

$$a_1 x + b_1 y + c_1 = 0 \quad ; \quad a_2 x + b_2 y + c_2 = 0$$

(2)

(i) Unique → $\dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2} \longrightarrow$ (intersecting)

(ii) infinite Sol^n $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} = \dfrac{c_1}{c_2}$ [coincident lines)

(1) (iii) no Sol^n $\boxed{\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} \neq \dfrac{c_1}{c_2}}$ [$\|$ lines]
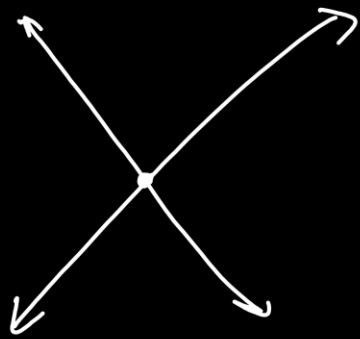
Parallel

one sol^n/unique
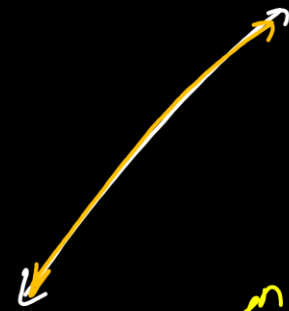(intersecting lines)
(i)
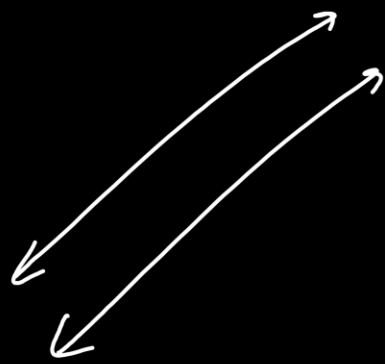
no sol^n
(parallel)
(ii)

∞ sol^n
(Coincident lines)
(iii)

Case (1) & (ii) $\rightarrow$ Consistent form

$$a_1x + b_1y + c_1 = 0$$

Q. Solve the following system of linear equations graphically

$$X - 2Y = 6$$
$$\boxed{3X - 6Y = 1}$$

$$a_1 = 1 \qquad b_1 = -2, \quad c_1 = -6$$
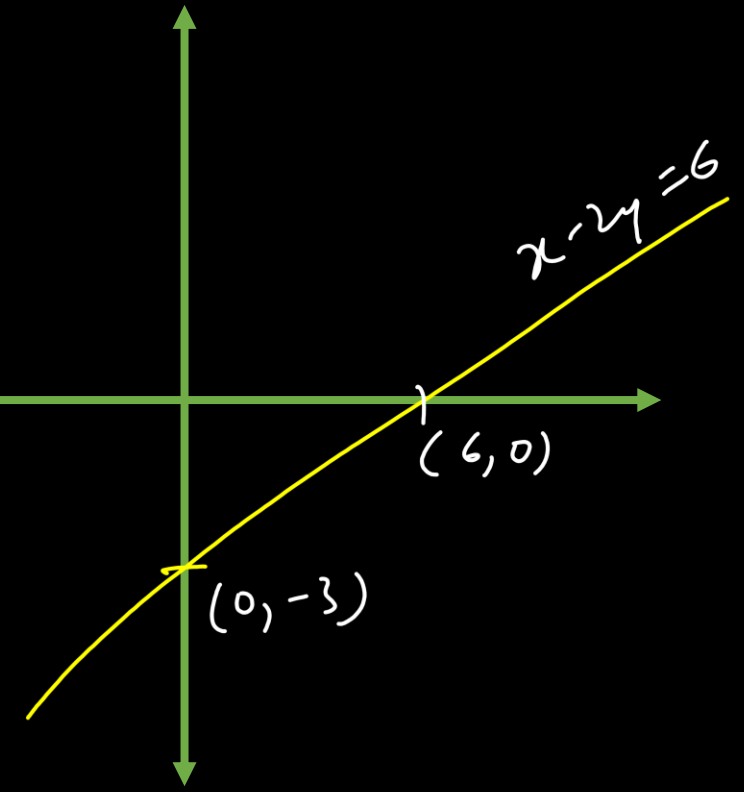$$a_2 = 3 \qquad b_2 = -6 \qquad c_2 = -1$$

$$\frac{a_1}{a_2} = \frac{1}{3} \quad ; \quad \frac{b_1}{b_2} = \frac{-2}{-6} = \frac{1}{3}$$

$$\frac{c_1}{c_2} = \frac{-6}{-1} = 6$$

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

X	0	6
y	-3	0

(6, 0)

(0, -3)

$x - 2y = 6$

Q. If the pair of equations represents coincident Lines, then the value of r is 2

$$3x - y + 8 = 0 \ \& \ 6x - ry + 16 = 0$$

$a_1 = 3$ $\qquad\qquad$ $a_2 = 6$

$b_1 = -1$ $\qquad\qquad$ $b_2 = -r$

$c_1 = 8$ $\qquad\qquad$ $c_2 = 16$

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

$$\frac{\overset{1}{\cancel{3}}}{\cancel{6}2} = \frac{-1}{-r} = \frac{\overset{1}{\cancel{8}}}{\cancel{16}2}$$

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

$$\boxed{r = 2}$$

Q. Find the value of k for which the system

$kx + 2y = 5$ & $3x + y = 1$ **has**

$k \neq 6$ **(i)**   **Unique solution**

$k = 6$ **(ii)**   **No solution**

$a_1 x + b_1 y + c_1 = 0$

$a_1 = k$, $b_1 = 2$, $c_1 = -5$

$a_2 = 3$ $b_2 = 1$ $c_2 = -1$

(1) unique sol^n

$$\frac{a_1}{a_2} \neq \frac{b_1}{b_2} \Leftrightarrow \frac{k}{3} \neq \frac{2}{1} (\Rightarrow) \boxed{k \neq 6}$$

(ii) no sol^n

$$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2} \Leftrightarrow \frac{k}{3} = \frac{2}{1} \neq \frac{-5}{-1}$$

$$\Rightarrow \boxed{k = 6} \quad \Big| \quad k \neq +15$$

Substitution method

Q. $2x - y = 6$ & $x - y = 2$

$x - y = 2$

$\boxed{x = 2 + y} \rightarrow \quad x = 2 + y$

$\qquad\qquad\qquad = 2 + 2$

$2x - y = 6 \qquad \boxed{x = 4} \quad , \boxed{y = 2}$

$2(2+y) - y = 6$

$4 + 2y - y = 6$

$y = 6 - 4 = 2$

$\boxed{y = 2}$

Q. Solve the following system of linear equations

$$100 \times (0.5x + 0.7y = \underline{0.74}) \quad \& \quad (0.3x + 0.5y = 0.5) \times 100$$

$$50x + 70y = 74$$

$$\Rightarrow 50x = 74 - 70y$$

$$\boxed{x = \frac{74 - 70y}{50}}$$

$$30x + 50y = 50$$

$$30\left[\frac{74 - 70y}{50}\right] + 50y = 50$$

$$\left[\frac{3 \times 74 - 210y}{5} + 50y = 50\right] \times 5$$

$$222 - 210y + 250y = 250$$

$$40y = 250 - 222$$

$$= 28$$

$$\boxed{y = \frac{28}{40}}$$

$$y = \frac{28}{40} = \frac{7}{10} = 0.7$$

$$x = \frac{74 - 30y}{50} = \frac{74 - 70\left(\frac{7}{10}\right)}{50}$$

$$= \frac{74 - 49}{50}$$

$$= \frac{25}{50} = 0.5$$

$$\left.\begin{array}{l} x = 0.5 \\ y = 0.7 \end{array}\right\}$$

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Elimination method

Q. Solve the following system of equation

$$\frac{2}{\sqrt{x}} + \frac{3}{\sqrt{y}} = 2 \quad \& \quad \frac{4}{\sqrt{x}} - \frac{9}{\sqrt{y}} = -1$$

$$\frac{1}{\sqrt{x}} = u \qquad \frac{1}{\sqrt{y}} = v$$

$$3 \times (2u + 3v = 2)$$

$$6u + 9v = 6$$

$$+ \quad 4u - 9v = -1$$

$$\overline{\quad 10u = 5 \quad}$$

$$\boxed{u = 1/2}$$

$$\& \quad 4u - 9v = -1$$

$$2u + 3v = 2$$

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

$$3v = 2 - 1$$

$$\boxed{v = 1/3}$$

$$u = \frac{1}{2} \qquad , \quad v = \frac{1}{3}$$

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

$$\frac{1}{2} = \frac{1}{\sqrt{x}} \implies \sqrt{x} = 2 \quad \boxed{x = 4}$$

$$\boxed{x = 4, \ 9}$$

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

$$\sqrt{y} = 3$$

$$y = 9$$

Q. Solve:

$$2 \times (x + \boxed{y} = 5xy) \quad \& \quad 3x + \boxed{2y} = 13xy$$

$$2x + 2y = 10xy$$

$$- \quad 3x + 2y = 13xy$$
$$\quad - \quad - \quad -$$

$$\overline{\quad\quad\quad\quad\quad}$$

$$-x = -3xy$$

$$\frac{+x}{+3x} = y \implies \boxed{y = \frac{1}{3}}$$

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

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

$$x - \frac{5x}{3} = -\frac{1}{3}$$

$$x = \underline{\quad\quad}$$

Q. Solve:

$$\frac{5}{x+y} - \frac{2}{x-y} = -1 \quad \& \quad \frac{15}{x+y} + \frac{7}{x-y} = 10$$

$$\Rightarrow \left(\frac{1}{x+y} = u\right) \& \left(\frac{1}{x-y} = v\right)$$

$$7 \times (5u - 2v = -1) \qquad (15u + 7v = 10)^2$$

$$35u - 14v = -7$$
$$+\quad 30u + 14v = 20$$
$$\overline{ 65u = 13}$$

$$u = \frac{13}{65} = \left(\frac{1}{5}\right)$$

$$5u - 2v = -1$$
$$5\left(\frac{1}{5}\right) - 2v = -1$$
$$1 - 2v = -1$$
$$1 + 1 = 2v$$
$$2 = 2v \ (\Rightarrow) \boxed{v = 1}$$

$$u = 1/5 \qquad v = 1$$

$$u = \frac{1}{x+y} \qquad v = \frac{1}{x-y}$$

$$\begin{aligned} \searrow \quad x+y &= 5 \\ + \quad x-y &= 1 \\ \hline 2x &= 6 \end{aligned}$$

$$\boxed{x = 3} \quad, \quad \boxed{y = 2}$$

$$\begin{aligned} x - y &= 1 \\ \hline 3 - y &= 1 \end{aligned}$$

$$\boxed{y = 2}$$

Q. Solve

$$152x - 378y = -74 \quad \& \quad -378x + 152y = -604$$

$$\underbrace{152x - 378y = -74}_{\angle \text{①}} \quad \& \quad \underbrace{-378x + 152y = -604}_{\angle \text{②}}$$

$$\begin{array}{c}
2 \quad 1 \\
x - y = 1 \\
x + y = 3 \\
\hline
2x = 4 \\
\boxed{x = 2} \\
\boxed{y = 1}
\end{array}$$

Add ① & ②

$$152x - 378y = -74$$
$$-378x + 152y = -604$$
$$\overline{-226x - 226y = -678}$$
$$+226(x+y) = +678$$
$$\boxed{x + y = \frac{678}{226} = 3}$$

① − ②

$$152x - 378y = -74$$
$$-378x + 152y = -604$$
$$+ \qquad - \qquad +$$
$$\overline{530x - 530y = 530}$$
$$\boxed{x - y = 1}$$

Q. One says, "give me a hundred, friend! I shall then become twice as rich as you". The other replies, "if you give me ten, I shall be six times as rich as you." what is the amount they have?

$y = 40$

$2x - y = 300$

$2x = 300 + y$

$2x = 300 + 40$

$x = \dfrac{340}{2}$

$\boxed{x = 170}$

$A \rightarrow (x)$ $R \rightarrow$ gain 100 $\xrightarrow{}$ (y) rupees

losing 100

$2(x - 100) = y + 100$

$2x - 200 = y + 100$

$2x - y = 300 - ①$

$-2x + 12y = -140$

$11y = 440$

$y = \dfrac{440}{11} = 40$

A R

$(x + 10) = 6(y - 10)$

$x + 10 = 6y - 60$

$x - 6y = -60 - 10$

$\boxed{x - 6y = -70 - ②} \times 2$

$2x - 12y = -140$

A

R

x

y

170

40

A   R

180

30   X6

70 →X2 140

Q. The sum of a two digit number and the number obtained by reversing the order of its digit is 99. if the digits differ by 3, find the number. $xy = 63$

$$xy \to 10x + y - \text{①}$$

$$yx \Rightarrow 10y + x - \text{②}$$

$57 \to 50 + 7$

$$(10x + y) + (10y + x) = 99$$

$$11x + 11y = 99 \Rightarrow 11(x+y) = 99$$

$$\boxed{x + y = 9}$$

$$x - y = 3 \longrightarrow$$

$$6 \qquad 3$$

$$2x = 12$$

$$\boxed{x = 6}$$

$$y = 3$$

Q. Ten years ago, a father was twelve times as old as his son and ten years hence, he will be twice as old as his son will be then. Find their present ages.

$\rightarrow$ $f \rightarrow x$ years $\left.\right\}$ present ages
$s \rightarrow y$ years

10 years ago
$f \rightarrow (x-10)$
$s \rightarrow (y-10)$

$x - 10 = 12(y-10)$

$x - 10 = 12y - 120$

$x - 12y = -120 + 10$

$x - 12y = -110$ ——①

10 years hence,
$f \rightarrow x + 10$
$s \rightarrow y + 10$

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

$x + 10 = 2y + 20$

$x - 2y = 20 - 10$

$x - 2y = 10$ ——②

$\textcircled{2} - \textcircled{1},\quad x - 2y = 10$

$\phantom{\textcircled{2} - \textcircled{1},\quad} x - 12y = -110$

$\phantom{\textcircled{2} - \textcircled{1},\quad} -\quad + \quad + $

$\overline{\phantom{\textcircled{2} - \textcircled{1},\quad xxxxxxx}}$

$\phantom{\textcircled{2} - \textcircled{1},} 10y = 120$

$\phantom{\textcircled{2} - \textcircled{1},xxx} y = \dfrac{120}{10} = 12$

$\boxed{Son's\ age = 12\ years}$

$x - 2y = 10$

$x = 10 + 2y = 10 + 2(12)$

$ = 10 + 24 = 34$

$\boxed{father's\ age = 34\ years}$

Q. The sum of the numerator and the denominator of a fraction is 12. If the denominator is increased by 3, the fraction becomes 1/2. find the fraction.

$$\Rightarrow \quad \frac{x}{y+3}$$

$$x + y = 12 \quad -①$$

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

$$\frac{5}{?}$$

$$\frac{5}{7+3} = \frac{5}{10} = \frac{1}{2}$$

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

$$2x - y = 3 \quad -②$$

$$x + y = 12$$

$$\overline{}$$

$$3x = 15$$

$$\boxed{x = 5}$$

$$y = 7$$

$$\frac{5}{7}$$

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Homework Questions

1. Find the value of k for which following system of equations has <u>infinitely many</u> solutions:

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

2. The sum of the <u>numerator</u> and <u>denominator</u> of a fraction is 4 more than twice the numerator. If numerator and denominator are increased by 3, they are in the ratio 2 : 3. Determine the fraction.

3. **Solve:** $\dfrac{7x - 2y}{xy}$ =5 & $\dfrac{8x + 7y}{xy} = 15$

$7u - 2v = 5$

$\dfrac{7}{y} - \dfrac{2}{x} = 5$

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