

Chapter 5
Simultaneous Linear Equations
Exercise 5.1

1.

Solution

(i) $x + y = 14$

$$x - y = 4$$

$$\therefore x + y = 14$$

$$x - y = 4$$

$$x = y + 4$$

$$x + y = 14$$

$$[y + 4] + y = 14$$

$$2y + 4 = 14$$

$$2y = 14 - 4$$

$$2y = 10$$

$$Y = \frac{10}{2}$$

$$x + y = 14$$

$$x + 5 = 14$$

$$x = 14 - 5$$

$$x = 9$$

$$x = 9 ; y = 5$$

$$(ii) \ s - t = 3 \dots(1)$$

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

$$2s + 3t = 6$$

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

$$(1) \ s - t = 3$$

$$S - \left(\frac{6-2s}{3}\right) = 3$$

$$S - 6 = 3$$

$$S = 6 + 3$$

$$= 9$$

$$S - t = 3$$

$$9 - t = 3$$

$$-t = 3 - 9$$

$$-t = -6$$

$$t = 6$$

$$\therefore s = 9, t = 6$$

$$(iii) \ 2x + 3y = 9 \dots(1)$$

$$3x + 4y = 5 \dots(2)$$

$$4y = 5 - 3x$$

$$Y = \frac{5-3x}{4}$$

$$(1) \ 2x + 3y = 9$$

$$2x + 3\left(\frac{5-3x}{4}\right) = 9$$

$$8x + 15 - 9x = 36$$

$$-x = 36 - 15$$

$$-x = 21$$

$$x = -21$$

$$\therefore 2x + 3y = 9$$

$$2(-21) + 3y = 9$$

$$-42 + 3y = 9$$

$$3y = 9 + 42$$

$$3y = 51$$

$$y = \frac{51}{3} = 17$$

$$\therefore x = -21, y = 17$$

$$(iv) 3x - 5y = 4 \dots (1)$$

$$9x - 2y = 7 \dots (2)$$

$$9x - 2y = 7$$

$$9x = 7 + 2y$$

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

$$3x - 5y = 4$$

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

$$21 + 6y - 45y = 36$$

$$-39y = 36 - 21$$

$$-39y = 15$$

$$-y = \frac{15}{39}$$

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

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

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

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

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

$$3x = \frac{27}{13}$$

$$X = \frac{27}{13}$$

$$X = \frac{9}{13}$$

2.

Solution

$$(i) a + 3b = 5 \dots(1)$$

$$7a - 8b = 6 \dots\dots(2)$$

$$a = \frac{6+8b}{7}$$

$$a + 3b = 5$$

$$\frac{6+8b}{7} + 3b = 5$$

$$6 + 8b + 21b = 35$$

$$6 + 29b = 35$$

$$29b = 35 - 6$$

$$b = \frac{29}{29}$$

$$b = 1$$

$$a + 3b = 5$$

$$a + 3(1) = 5$$

$$a = 5 - 3$$

$$a = 2$$

$$\therefore a = 2, b = 1$$

$$(ii) \quad 5x + 4y - 4 = 0$$

$$X - 20 = 12y$$

$$\therefore x - 20 = 12y$$

$$Y = \frac{x-20}{12}$$

$$5x + 4y - 4 = 0$$

$$5x + 4 \left(x - \frac{20}{12} \right) - 4 = 0$$

$$60x + 4x - 80 - 48 = 0$$

$$64x - 128 = 0$$

$$64x = 128$$

$$X = \frac{128}{64}$$

$$X = 2$$

$$5x + 4y - 4 = 0$$

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

$$10 + 4y - 4 = 0$$

$$6 + 4y = 0$$

$$4y = 6$$

$$Y = \frac{6}{4} = \frac{3}{2}$$

$$\therefore x = 2, y = \frac{3}{2}$$

3.

Solution

$$(i) 2x - \frac{3y}{4} = 3 \dots(1)$$

$$5x - 2y - 7 = 0 \dots(2)$$

$$8x = 12 + 3y$$

$$X = \frac{12+3y}{8}$$

$$5\left(\frac{12+3y}{8}\right) - 2y - 7 = 0$$

$$60 + 15y - 16y - 56 = 0$$

$$-y = 56 - 60$$

$$Y = 4$$

$$Y = 4$$

$$6x - 2y - 7 = 0$$

$$5x - 2(4) - 7 = 0$$

$$5x - 8 - 7 = 0$$

$$5x - 15 = 0$$

$$5x = 15$$

$$X = \frac{15}{5}$$

$$X = 3$$

$$\therefore x = 3, y = 4$$

$$(ii) 2x + 3y = 23$$

$$5x - 20 = 8y$$

$$Y = \frac{5x-20}{8}$$

$$2x + 3\left(\frac{5x-20}{8}\right) = 23$$

$$16x + 15x - 60 = 184$$

$$31x = 184 + 60$$

$$31x = 244$$

$$X = \frac{244}{31} = 7 \frac{27}{31}$$

$$2x + 3y = 23$$

$$2\left(\frac{244}{31}\right) + 3y = 23$$

$$3y = 23 - \frac{488}{31}$$

$$3y = \frac{225}{31}$$

$$Y = \frac{225}{31} \div 3$$

$$Y = \frac{75}{31}$$

$$Y = 2\frac{13}{31}$$

$$\therefore x = 7\frac{27}{31} \quad y = \frac{2.13}{31}$$

4.

Solution

$$(i) \quad mx - ny = m^2 + n^2 \quad \dots\dots(i)$$

$$X + y = 2m \quad \dots\dots\dots(ii)$$

Substitute (ii) in (i)

$$\therefore x = 2m - y$$

$$\Rightarrow m(2m - y) - ny = m^2 + n^2$$

$$2m^2 - my - ny = m^2 + n^2$$

$$2m^2 - y(m + n) = m^2 + n^2$$

$$2m^2 - y(m + n) = m^2 + n^2$$

$$2m^2 - m^2 - n^2 = y(m + n)$$

$$m^2 - n^2 = y(m + n)$$

$$(m + n) (m - n) = y(m + n)$$

$$\therefore y = m - n$$

$$x = 3m - y$$

$$= 2m - m + n$$

$$x = m + n$$

$$\therefore x = m + n$$

$$Y = m - n$$

$$(ii) \frac{b}{a}x + \frac{a}{b}y = a^2 + b^2$$

$$\frac{b}{a}x + \frac{a}{b}y = a^2 + b^2$$

$$x + y = 2ab$$

$$x = 2ab - y$$

$$\therefore \frac{b}{a}(2ab - y) + \frac{a}{b}y = a^2 + b^2$$

$$\frac{b}{a} \cdot 2ab - \frac{b}{a} \cdot y + \frac{a}{b}y = a^2 + b^2$$

$$2b^2 - y\left(\frac{b}{a} - \frac{a}{b}\right) = a^2 + b^2$$

$$2b^2 - a^2 - b^2 = y\left(\frac{b^2 - a^2}{ab}\right)$$

$$b^2 - a^2 = y\left(\frac{b^2 - a^2}{ab}\right)$$

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

$$Y = ab$$

$$x = 2ab - y$$

$$x = 2ab - ab$$

$$= ab$$

5.

Solution

$$2x + y = 35$$

$$3x + 4y = 65$$

$$3x + 4y = 65$$

$$4y = 65 - 3x$$

$$Y = \frac{65 - 3x}{4}$$

$$2x + y = 35$$

$$2x + \frac{65 - 3x}{4} = 35$$

$$8x + 65 - 3x = 140$$

$$8x - 3x = 140 - 65$$

$$5x = 75$$

$$x = 15$$

$$2x + y = 35$$

$$2x + y = 35$$

$$2(15) + y = 35$$

$$30 + y = 35$$

$$Y = 35 - 30$$

$$= 5$$

$$\therefore x = 15, y = 5$$

$$\therefore \frac{x}{y} = \frac{15}{5} = 3$$

6.

Solution

$$3x - y = 5$$

$$4x - 3y = -1$$

$$3x = 5y + y$$

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

$$4\left(5 + \frac{y}{3}\right) - 3y = -1$$

$$20 + 4y - 9y = -3$$

$$-5y = -3 - 20$$

$$-5y = -23$$

$$Y = \frac{23}{5}$$

$$3x - y = 5$$

$$15x - \frac{23}{5} = 5$$

$$15x - 23 = 25$$

$$15x = 25 + 23$$

$$15x = 48$$

$$X = \frac{48}{15} = \frac{16}{5}$$

$$Y = px - 3$$

$$\frac{23}{5} = p\left(\frac{16}{5}\right) - 3$$

$$\frac{23}{5} = \left(\frac{16p}{5}\right) - 15$$

$$\frac{23}{5} - 15 = \frac{16p}{5}$$

$$P = \frac{19}{8}$$

Exercise 5.2

1.

Solution

$$(i) \ 3x + 4y = 10 \dots(1)$$

$$2x - 2y = 2\dots\dots(2)$$

$$X = \frac{2+2y}{2}$$

$$3\left(\frac{2+2y}{2}\right) + 4y = 10$$

$$\frac{6+6y}{2} + 4y = 10$$

$$6 + 6y + 8y = 20$$

$$6 + 14y = 20$$

$$14y = 20 - 6$$

$$14y = 14$$

$$Y = 1$$

$$3x + 4y = 10$$

$$3x = 10 - 4$$

$$3x = 6$$

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

$$x = 2$$

$$\therefore x = 2, y = 1$$

$$(ii) 2x = 5y + 4$$

$$3x - 2y + 16 = 0$$

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

$$3\left(\frac{5y+4}{2}\right) - 2y + 16 = 0$$

$$\frac{15y+12}{2} - 2y + 16 = 0$$

$$15y + 12 - 4y + 32 = 0$$

$$11y + 44 = 0$$

$$11y = -44$$

$$Y = -\frac{44}{11} = -4$$

$$Y = -4$$

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

$$2x = -20 + 4$$

$$2x = -16$$

$$x = -\frac{16}{2}$$

$$x = -8$$

$$\therefore x = -8, y = -4$$

2.

Solution

$$(i) \frac{3}{4}x - \frac{2}{3}y = 1$$

$$\frac{3}{8}x - \frac{1}{6}y = 1$$

$$\frac{3}{8}x = 1 + \frac{1}{6}y$$

$$X = \left(1 + \frac{1}{6}y\right) \frac{8}{3}$$

$$\therefore \frac{3}{4} \left(1 + \frac{1}{6}y\right) \cdot \frac{8}{3} - \frac{2}{3}y = 1$$

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

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

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

$$\therefore y = 3$$

$$\therefore \frac{3}{4}x - \frac{2}{3} \cdot (3) = 1$$

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

$$\frac{3}{4}x = 3$$

$$X = \frac{3 \times 4}{3}$$

$$X = 4$$

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

$$\frac{2}{3}x + 4y + \frac{1}{2} = 0$$

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

$$2x = 3y + 3$$

$$X = \frac{3y+3}{2}$$

$$\therefore \frac{2}{3} \left(3y + \frac{3}{2} \right) + 4y + \frac{1}{2} = 0$$

$$\frac{2}{3} \cdot \frac{3}{2} (y + 1) + 4y + \frac{1}{2} = 0$$

$$Y + 1 + 4y + \frac{1}{2} = 0$$

$$5y + \frac{3}{2} = 0$$

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

$$Y = -\frac{3}{10}$$

$$\therefore 2x - 3y - 3 = 0$$

$$2x - 3 \left(-\frac{3}{10} \right) - 3 = 0$$

$$2x + \frac{9}{10} - 3 = 0$$

$$2x = 3 - \frac{9}{10}$$

$$x = \frac{30-9}{10}$$

$$x = \frac{21}{10}$$

3.

Solution

$$(i) \ 15x - 14y = 117$$

$$14x - 15y = 115$$

$$14x = 115 + 15y$$

$$x = \frac{115+15y}{14}$$

$$\therefore 15 \left(\frac{115+15y}{14} \right) - 14y = 117$$

$$1725 + 225y - 196y = 117 \times 14$$

$$1725 + 225y - 196y = 1638$$

$$29y = +1638 - 1725$$

$$29y = -87$$

$$Y = -\frac{87}{29}$$

$$Y = -3$$

$$\therefore 15x - 14(-3) = 117$$

$$15x + 42 = 117$$

$$15x = 117 - 42$$

$$15x = 75$$

$$X = \frac{75}{15}$$

$$X = 5$$

$$(ii) 41x + 53y = 135$$

$$53x + 41y = 147$$

$$53x = 147 - 41y$$

$$X = \frac{147-41y}{53}$$

$$41x + 53y = 135$$

$$41\left(\frac{147-41y}{53}\right) + 53y = 135$$

$$6027 - 1681y + 2809y = 135 \times 53$$

$$6027 - 1681y + 2809y = 7155$$

$$1128y = 1128$$

$$Y = \frac{1128}{1128}$$

$$Y = 1$$

$$\therefore 41x + 53y = 135$$

$$41x + 53(1) = 135$$

$$41x = 135 - 53$$

$$41x = 82$$

$$X = \frac{82}{41}$$

$$X = 2$$

4.

Solution

$$(i) \frac{x}{6} = y - 6$$

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

$$Y = \frac{3x}{4} - 1$$

$$\therefore \frac{x}{6} = \frac{3x}{4} - 1 - 6$$

$$\frac{x}{6} = \frac{3x}{4} - 7$$

$$\frac{x}{6} = \frac{3x-28}{4}$$

$$\frac{x}{3} = \frac{3x-28}{2}$$

$$2x = 3x - 84$$

$$3x - 2x = 84$$

$$x = 84$$

$$x = \frac{84}{7}$$

$$x = 12$$

$$\therefore \frac{x}{6} = y - 6$$

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

$$Y = 2 + 6$$

$$Y = 8$$

$$(ii) \quad x - \frac{2}{3}y = \frac{8}{3}$$

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

$$Y = \frac{2x}{5} - \frac{7}{5}$$

$$Y = \frac{2x-7}{5}$$

$$\therefore x - \frac{2}{3} \left(2x - \frac{7}{5} \right) = \frac{8}{3}$$

$$x - \frac{4x-14}{15} = \frac{8}{3}$$

$$15x - 4x + 14 = 8 \times 5$$

$$11x + 14 = 40$$

$$11x = 40 - 14$$

$$11x = 26$$

$$X = \frac{26}{11}$$

$$\therefore \frac{26}{11} - \frac{2}{3}y = \frac{8}{3}$$

$$\frac{2}{3}y = \frac{26}{11} - \frac{8}{3}$$

$$\frac{2}{3}y = \frac{78-88}{33}$$

$$Y = \frac{10}{33} \times \frac{3}{2} = \frac{5}{11}$$

5.

Solution

$$(i) \ 9 - (x - 4) = y + 7$$

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

$$\Rightarrow 9 - x + 4 = y + 7$$

$$13 - x = y + 7$$

$$Y = 13 - x - 7$$

$$Y = 6 - x$$

$$\therefore 2(x + 6 - x) = 4 - 3(6 - x)$$

$$2x + 12 - 2x = 4 - 18 + 3x$$

$$12 = -14 + 3x$$

$$3x = 12 + 14$$

$$3x = 26$$

$$X = \frac{26}{3}$$

$$Y = 6 - x$$

$$Y = 6 - \frac{26}{3}$$

$$Y = \frac{18-26}{3}$$

$$Y = -\frac{8}{3}$$

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

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

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

$$X - y = 3$$

$$X = 3 + y$$

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

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

$$6 + 2y + \frac{1}{2} = 2$$

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

$$2y = \frac{4-1-12}{2}$$

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

$$Y = -\frac{9}{4}$$

$$X = 3 + y$$

$$X = 3 - \frac{9}{4}$$

$$X = \frac{12-9}{4}$$

$$X = \frac{3}{4}$$

6.

Solution

$$(i) \quad 4x + \frac{x-y}{8} = 17$$

$$\Rightarrow \frac{32x+x-y}{8} = 17$$

$$3x - y = 136 \dots\dots(i)$$

And

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

$$Y + 3x - 2 = 6$$

$$Y + 3x = 6 + 2$$

$$Y + 3x = 8$$

$$Y = 8 - 3x \dots\dots(ii)$$

Equation (ii) in equation (i)

$$\therefore 33x - 8 + 3x = 136$$

$$36x = 136 + 8$$

$$36x = 144$$

$$X = \frac{144}{36}$$

$$X = 4$$

$$\therefore y = 8 - 3(4)$$

$$= 8 - 12$$

$$= -4$$

$$(ii) \text{ given } x - 3y = 3x - 1 = 2x - y$$

$$\therefore x - 3y = 3x - 1$$

$$3x - x = 1 - 3y$$

$$2x = 1 - 3y$$

$$2x = 1 - 3y$$

$$2x + 3y = 1 \dots\dots(i)$$

$$\therefore 3x - 1 = 2x - y$$

$$3x - 2x = 1 + y$$

$$X = 1 + y \dots\dots(ii)$$

Equation (ii) in equation (i)

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

$$2 + 2y + 3y = 1$$

$$5y = 1 - 2$$

$$5y = -1$$

$$Y = -\frac{1}{5}$$

$$X = y + 1$$

$$X = -\frac{1}{5} + 1$$

$$X = \frac{-1+5}{5}$$

$$X = \frac{4}{5}$$

7.

Solution

$$\text{Given } \frac{3}{x} + 4y = 7$$

$$\frac{5}{x} + 6y = 13$$

$$\frac{5}{x} = 13 - 6y$$

$$\text{Or } 6y = 13 - \frac{5}{x}$$

$$6y = \frac{13x-5}{x}$$

$$Y = \frac{13x-5}{6x}$$

$$\frac{3}{x} + 4y = 7$$

$$\frac{3}{x} + 4\left(\frac{13x-5}{6x}\right) = 7$$

$$\frac{3}{x} + \frac{52x-20}{6x} = 7$$

$$52x - 20 = 42x$$

$$52x - 42x = 20$$

$$10x = 20$$

$$X = \frac{2}{10}$$

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

$$Y = \frac{13\left(\frac{1}{5}\right) - 5}{6\left(\frac{1}{5}\right)}$$

$$Y = \frac{\frac{13}{5} - 5}{\frac{6}{5}}$$

$$Y = \frac{\frac{13}{5} - 5}{\frac{6}{5}}$$

$$Y = -\frac{12}{6}$$

$$Y = -2$$

$$(ii) \quad 5x - 9 = \frac{1}{y}$$

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

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

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

$$= 5\left(3y - \frac{1}{y}\right) - 9 = \frac{1}{y}$$

$$\frac{15y - 5}{y} - 9 = \frac{1}{y}$$

$$\frac{15y - 5 - 9y}{y} = \frac{1}{y}$$

$$6y - 5 = 1$$

$$6y = 1 + 5$$

$$6y = 6$$

$$Y = \frac{6}{6}$$

$$Y = 1$$

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

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

$$x = 2$$

8 .

Solution

$$(i) \quad px + qy = p - q$$

$$qx - py = p + q$$

$$qx = p + q + py$$

$$x = \frac{q+p(1+y)}{q}$$

$$\therefore p\left(q + \frac{p(1+y)}{q}\right) + qy = p - q$$

$$\frac{pq+p^2(1+y)}{q} + qy = p - q$$

$$\frac{pq+p^2(1+y)}{q} + q^2 y = p - q$$

$$Pq + p^2(1 + y) + q^2 y = pq - q^2$$

$$P^2(1+y) = -q^2 - q^2y$$

$$P^2(1+y) = -q^2(1+y)$$

$$P^2 + p^2y = -q^2 - q^2y$$

$$P^2y + q^2y = -q^2 - p^2$$

$$Y(p^2 + q^2) = -(p^2 + q^2)$$

$$Y = -1$$

$$\therefore X = \frac{q+p(1+y)}{q}$$

$$X = \frac{q+p(1-1)}{q}$$

$$X = \frac{q+p(0)}{q}$$

$$X = \frac{q+0}{q}$$

$$X = \frac{q}{q}$$

$$X = 1$$

$$\therefore X = 1$$

$$Y = -1$$

$$(ii) \frac{x}{a} - \frac{y}{b} = 0$$

$$ax + by = a^2 + b^2$$

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

$$x = \frac{a}{b} \cdot y.$$

$$\Rightarrow a \cdot \frac{a}{b} \cdot y + by = a^2 + b^2$$

$$\frac{a^2}{b}y + by = a^2 + b^2$$

$$\frac{a^2y + b^2y}{b} = a^2 + b^2$$

$$(a^2 + b^2)y = (a^2 + b^2) - b$$

$$Y = b$$

$$\therefore x = \frac{a}{b} \cdot b$$

$$x = a$$

9.

Solution

$$\text{Given } 2x + y = 23$$

$$4x - y = 19$$

$$Y = 23 - 2x$$

$$\therefore 4x - 23 + 2x = 19$$

$$6x = 19 + 23$$

$$6x = 42$$

$$X = \frac{42}{6}$$

$$X = 7$$

$$Y = 23 - 2x$$

$$Y = 23 - 2(7)$$

$$Y = 23 - 14$$

$$Y = 9$$

$$\begin{aligned}\therefore x - 3y &= 7 - 3(9) = 7 - 27 \\ &= -20\end{aligned}$$

$$\therefore x - 3y = -20$$

$$\begin{aligned}5y - 2x &= 5(9) - 2(7) \\ &= 45 - 14 \\ &= 31\end{aligned}$$

$$5y - 2x = 31$$

10.

Solution

Given expression $ax + by$

$$(i) \quad ax + by = 7$$

When $x = 2; y = 1$

$$\therefore 2a + b = 7 \dots\dots(i)$$

$$(ii) \quad ax + by = 1$$

When $x = -1, y = 1$

$$-a + b = 1 \dots\dots(ii)$$

$$\therefore b = 1 + a$$

$$2a + 1 + a = 7$$

$$3a + 1 = 7$$

$$3a = 7 - 1$$

$$3a = 6$$

$$a = \frac{6}{3}$$

$$a = 2$$

$$\therefore b = 1 + a$$

$$b = 1 + 2$$

$$= 3$$

11.

Solution

Let the number be $xy[10x + y]$

Reverse of that number $yx[10y + x]$

And given that $\frac{xy[10x+y]}{yx[10y+x]} = 1\frac{3}{4}$

$$= \frac{10x+y}{10y+x} = \frac{7}{4}$$

$$= 40x + 4y = 70y + 7x$$

$$= 33x - 66y = 0$$

$$= x - 2y = 0 \dots\dots(i)$$

And also given that $x + y = 12\dots(ii)$

On solving equation(1) and equation(2)

$$(2)-(1) = x + y - x + 2y = 12$$

$$3y = 12$$

$$Y = 4$$

Put $y = 4$ in equation (1)

$$= x - 8 = 0$$

$$= x = 8$$

The required number is 84

12.

Solution

Let the number be $xy [10x + y]$ and reverse of number is

$yx[10y + x]$

$$\text{Given } \frac{10x+y}{10y+x} = \frac{5}{6}$$

$$= 60x + 6y = 50y + 5x$$

$$= 55x - 44y = 0$$

$$= 5x - 4y = 0 \dots(i)$$

And also given that $x - y = 1 \dots(ii)$

Put $x = y$ in equation (i)

$$5y + 5 - 4y = 0$$

$$Y = -5$$

Put $y = -5$ in equation 2

$$= x = -4$$

∴ the required number is 45

13

Solution

Let the number be xyz $[100x + 10y + z]$

Given that $x = 4$(i)

$x + y + z = 14$(ii)

and reverse of the number is zyx $[100z + 10y + x]$

and given that $(100x + 10y + z) - (100z + 10y + x) = 594$

$$= 99x - 99z = 594$$

$$= 99(x - z) = 594$$

$$= x - z = 6 \text{.....(3)}$$

On solving equation (1) and (3)

$$4 - z = 6$$

$$-z = 2$$

$$z = -2$$

Put $z = -2$ in equation (3) $= x - (-2) = 6$

$$= x = 4$$

Put $x = 4$ and $z = -2$ in equation (2) $= 4 + y - 2 = 14$

$$= y = 12$$

The required number is 428

14.

Solution

Let the age of marina and her daughter be 'm' and 'o'

Given that

$$m - 4 = 3(D-4) \dots(1)$$

$$m + 6 = 2(d + 6) \dots\dots(2)$$

$$\text{equation (1)} = m - 4 = 3d - 12$$

$$= m = 3d - 8 \dots\dots(3)$$

$$\text{Equation (2)} = m + 6 = 2d + 12$$

$$= m = 2d + 6 \dots\dots(4)$$

$$\text{From (3) and (4)} \quad 3d - 8 = 2d + 6$$

$$D = 14$$

Put $d = 14$ in equation (4)

$$m = 28 + 6 = 34$$

$$m = 34$$

$\therefore$ the present age of marina and her daughter is 34 and 14

$$\text{Equation (1)} \times 12 = 144x + 120y = 1560000$$

$$\text{Equation (2)} \times 10 = 100x + 120y = 1340000$$

$$\begin{array}{r} (-) \qquad \qquad (-) \qquad \qquad (-) \\ \hline \end{array}$$

$$44x = 22000$$

$$X = 5000$$

Put $x = 5000$ in equation (1)

$$60000 + 10y = 130000$$

$$10y = 70000$$

$$Y = 7000$$

Thus the money invested at 12% is 5000/-

10% is 1000/-

15.

Solution

Let the cost price of table be x and list price of chair be 'y'

Case(i)

Table is sold at a profit of 8%

$$\therefore \text{s.p. of table} = x + \frac{8x}{100} = \frac{108x}{100}$$

Chair is sold at a discount of 10%

$$\therefore \text{s.p. of chair} = y - \frac{10y}{100} = \frac{90y}{100}$$

$$\text{And given that } \frac{108x}{100} + \frac{90y}{100} = 1008$$

$$= 6x + 5y = 5600 \dots (1)$$

Case (ii)

Table is sold at a profit of 10%

$$\therefore \text{sp of table} = x + \frac{10x}{100} = \frac{110x}{100}$$

Chair is sold at a discount of 8%

$$\therefore \text{sp of chair} = y - \frac{8y}{100} = \frac{92y}{100}$$

Given that

$$\frac{110x}{100} + \frac{92y}{100} = 1028$$

$$= 110x + 92y = 102500 \dots (2)$$

On solving equation (1) and (2) $x = 600$ $y = 400$

$\therefore$ cost price of table is 600/- and list price of chair is 400/-

16.

Solution

Let the money had by A and B is x and y respectively

Case(i)

Given that

$$x + 100 = 75 \% (y - 100)$$

$$= x + 100 = \frac{375}{100} (y - 100)$$

$$= 4x + 400 = 3y - 300$$

$$= 4x - 3y = -700 \dots (i)$$

Case 2

$$X - 100 = 40 \% (y + 100)$$

$$= x - 100 = \frac{40}{100} (y + 100)$$

$$= 5x - 500 = 2y + 200$$

$$= 5x - 2y = 700 \dots (2)$$

$$\text{Equation (i)} \times 2 = 8x - 6y = -1400$$

$$\text{Equation (ii)} \times 3 = \underline{15x - 6y = 2100}$$

$$7x = 3500$$

$$X = 500$$

$$\text{Put } x = 500 \text{ in equation (2)} = 2500 - 2y = 700$$

$$2y = 1500$$

$$Y = 900$$

$\therefore$ A and B have 500/- and 900/- respectively

17.

Solution

Let the number of rows be x

Number of students in one row be y

$\therefore$ total no. of student = xy

Given (i) if one student is extra in a row , there will be 2 rows less

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

$$= xy - 2y + x - 2 = xy$$

$$= x - 2y = 2 \dots\dots(i)$$

(ii) if one student is less in row there will be 3 rows more.

$$= (y - 1) (x + 3) = xy$$

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

$$= x - 3 = -3 \dots\dots(2)$$

Equation (i) and equation (2)

$$Y = 5$$

Put $y = 5$ in (i)

$$= x - 10 = 2$$

$$= x = 12$$

$\therefore$ no. of student in the class is $12 \times 5 = 60$

18.

Solution

Let x grams of 18 carat gold is added there the amounts

Of 12 carat gold added is $(120 - x)$ grams

Given purity of gold is 24 carat

$$\therefore x \frac{18}{24} + (120 - x) \cdot \frac{12}{24} = 120 \times \frac{16}{24}$$

$$= 18x + 12(120 - x) \cdot \frac{12}{24} = 120 \times 16$$

$$= 18x + 12 \times 120 - 12 \times x = 120 \times 16$$

$$= 6x = 120(16 - 12)$$

$$= x = \frac{120 \times 4}{6} = 80$$

$\therefore$ so grams is 18 carat gold added with $120 - 80 = 40$ grams]

Of 12 carat gold .

19.

Solution

Given A and B both can do work in 5 days

$$(A + B) \text{ one day's work} = \frac{1}{5}$$

$$\frac{A's \text{ 1 day's work}}{B's \text{ 1 day's work}} = \frac{\frac{3}{5}}{1} = \frac{3}{5}$$

Let A's 1 day's work be $3x$ and B's 1 day's work be $2x$

$$\text{Then } 3x + 2x = \frac{1}{5}$$

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

$$x = \frac{1}{25}$$

$$\therefore A's \text{ 1 day's work} = 3 \times \frac{1}{25} = \frac{3}{25}$$

$$B's \text{ 1 day's work} = 2 \times \frac{1}{25} = \frac{2}{25}$$

$\therefore$ A and B can do that work in 25 and 37.5 days

20.

Solution

Let a man's rate be 'm'

Women's rate be 'w'

$$\text{Given } 2m + 5w = \frac{1}{4}$$

$$m + w = \frac{1}{12}$$

$$= 8m + 20w = 1 \dots\dots(1)$$

$$= 12m + 12w = 1\dots\dots(2)$$

$$\text{Equation (1)} \times 3 = 24m + 60w = 3$$

$$\text{Equation (2)} \times 2 = \underline{24m + 24w = 2}$$

$$36w = 1$$

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

$$W = \frac{1}{36} \text{ in (2)}$$

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

1 man would take 18 days to complete the work .

21.

Solution

Let the speed of train be 'x' kmph and scheduled time by 'y'

Therefore length of the journey = xy m

$$\text{Given (i) } (x + 30)(y - 2) = xy \quad \text{(ii) } (x - 16)(y + 2) = xy$$

$$= xy - 2x + 30y - 60 = xy \quad xy + 2x + 15y - 30 = xy$$

$$= 2x - 30y + 60 = 0 \dots\dots(i) \quad 2x - 15y - 30 = 0 \dots\dots(2)$$

Equation (2) and equation(1)

$$15y - 90 = 0$$

$$= 15y = 90$$

$$= y = 6$$

$$\text{Put } y = 6 \text{ in (1)} = 2x - 180 + 60 = 0$$

$$= 2x = 120$$

$$x = 60$$

$\therefore$ the length of the journey is $60 \times 6 = 360$

22.

Solution

Let speed of boat in still water be x km/h

Speed current be ' y ' km/h

Time to go with the current is 2hrs

$$= \frac{40}{x+y} = 2 \quad \text{time} = \frac{\text{distance}}{\text{speed}}$$

$$= x + y = 20 \dots(i)$$

Time to go against the current is 4 hrs

$$= \frac{40}{x-y} = 4$$

$$= x - y = 10 \dots(2)$$

$$\text{Equation (1) and (2)} = 2x = 30$$

$$X = 15$$

$$\text{Put } x = 15 \text{ in (1)} = 15 + y = 20$$

$$= y = 5$$

Speed of boat in still water and speed of current is 15km/h and 5 km/h .

23.

Solution

Let the speed of boat in still water be 'x' km/h

Speed of boat current 'y' km/h

Time to go with the current is 4 hr. 48mins

$$= 28 \text{ min}$$

$$= \frac{24}{5} \text{ hrs}$$

$$\Rightarrow \frac{44}{x-y} = \frac{24}{5}$$

$$= 6x - 6y = 55 \dots(2)$$

$$\text{Eq}(2) + \text{eq}(1) \times 6 = 12x = 121$$

$$= x = \frac{121}{12} \text{ km/h} - \text{speed of boat in still water}$$

$$\text{Put } x = \frac{121}{12} \text{ in (i)} = y = 11 - \frac{121}{12}$$

$$Y = \frac{11}{12} \text{ km/h} - \text{speed of current}$$

24.

Solution

Let the plane air speed be 'x' km/h and wind speed be 'y' km/h

And given that with a head wind it to 3.5 hrs

$$= \frac{1650}{x-y} = 450 \dots(1)$$

On return it took 3hrs

$$= \frac{1680}{x+y} = 3$$

$$= x + y = 560 \dots\dots(2)$$

$$(1) + (2) = 22 = 1040$$

$$X = 520$$

$$\text{Put } x = 520 \text{ in } (2) = 520 + y = 560$$

$$= y = 40$$

Plane air speed is 520 km/h and wind speed 40 km/h

25.

Solution

Let the fixed charge be 'x' and cost of food per day be 'y'

Given that bhawana paid 2600 for 20 days

$$= x + 20y = 2600 \dots(1)$$

And divya paid 3020 for 26 days

$$= x + 26y = 3020 \dots(2)$$

$$\text{Equation (2) and equation(1) } = 6y = 420$$

$$Y = 70$$

$$\text{Put } y = 70 \text{ in } (1)$$

$$= x + 1400 = 2600$$

$$= x = 1200$$

Fixed charges = 1200/-

Cost of food per day – 70/-

Chapter test

Solve the following simultaneous linear equation (1 to 4):

$$1 \text{ (i) } 2x - \left(\frac{3}{4}\right)y = 3$$

$$5x - 2y = 7$$

Solution :

$$2x - \left(\frac{3}{4}\right)y = 3$$

$$\frac{8x-3y}{4} = 3$$

$$8x - 3y = 12 \dots(i)$$

$$5x - 2y = 7 \dots(ii)$$

Multiply (i) by 5 and (ii) by 8 , we get

$$40x - 15y = 60 \text{ (iii)}$$

$$40x - 16y = 56 \text{ (iv)}$$

Subtract (iv) from (iii) we get

$$Y = 4$$

Substitute y in (i)

$$8x - 3 \times 4 = 12$$

$$8x = 12 + 12$$

$$8x = 24$$

$$X = \frac{24}{8}$$

$$X = 3$$

Hence $x = 3$ and $y = 4$

$$(ii) 2(x - 4) = 9y + 2$$

$$X - 6y = 2$$

Solution

$$2(x - 4) = 9y + 2$$

$$2x - 8 = 9y + 2$$

$$2x - 9y = 2 + 8$$

$$2x - 9y = 10 \dots (i)$$

$$X - 6y = 2 \dots (ii)$$

Multiply (ii) by 2 , we get

$$2x - 12y = 4 \dots (iii)$$

Subtract (iii) from (i) we get

$$2x - 9y = 10$$

$$-2x + 12y = -4$$

$$0 + 3y = 6$$

$$3y = 6$$

$$Y = \frac{6}{3}$$

$$Y = 2$$

Substitute the value of y in (i)

$$2x - 9 \times 2 = 10$$

$$2x - 18 = 10$$

$$2x = 10 + 18$$

$$2x = 28$$

$$X = \frac{28}{2}$$

$$x = 14$$

hence $x = 14$ and $y = 2$

$$2 . (i) \quad 97x + 53y = 177$$

$$53x + 97y = 573$$

Solution :

Given equation are as follow

$$97x + 53y = 177 \dots(i)$$

$$53x + 97y = 573 \dots(ii)$$

Multiply (i) by 53 and (ii) by 97

$$53(97x + 53y) = 53 \times 177$$

$$5141x + 2809y = 9381 \dots(\text{iii})$$

$$97(53x + 97y) = 97 \times 573$$

$$5141x + 9409y = 55581 \dots(\text{iv})$$

Subtract (iv) from (iii)

$$5141x + 2809y = 9381 \dots(\text{iii})$$

$$5141x + 9409y = 55581 \dots(\text{iv})$$

$$0x - 6600y = -46200$$

$$-6600y = -46200$$

$$Y = \frac{-46200}{-6600}$$

$$Y = 7$$

Substitute the value of y in (i)

$$97x + 53 \times 7 = 177$$

$$97x + 371 = 177$$

$$97x = 177 - 371$$

$$97x = -194$$

$$x = -\frac{194}{97}$$

$$x = -2$$

hence $x = -2$ and $y = 7$

$$(ii) x + y = 5.5$$

$$X - y = 0.9$$

Solution

$$x + y = 5.5 \dots(i)$$

$$x - y = 0.9 \dots(ii)$$

Adding (i) and (ii) we get

$$2x = 5.5 + 0.9$$

$$2x = 6.4$$

$$x = \frac{6.4}{2}$$

$$x = 3.2$$

substituting value of x in (i)

$$3.2 + y = 5.5$$

$$Y = 5.5 - 3.2$$

$$Y = 2.3$$

Hence $x = 3.2$ and $y = 2.3$

3. (i) $x + y = 7xy$

$2x - 3y + xy = 0$

Solution :

$x + y = 7xy$ (i)

$2x - 3y + xy = 0$ (ii)

Divide (i) by xy , we get

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

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

$$\frac{1}{x} + \frac{1}{y} = 7$$
(iii)

Divide (ii) by xy , we get

$$\frac{2x}{xy} - \frac{3y}{xy} + \frac{xy}{xy} = 0$$

$$\frac{2}{y} - \frac{3}{x} + 1 = 0$$

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

Multiplying (iii) by 3 , we get

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

$$\frac{3}{x} + \frac{3}{y} = 21 \text{(v)}$$

Adding (v) and (iv) we get

$$\frac{5}{y} = 20$$

$$Y = \frac{5}{20}$$

$$Y = \frac{1}{4}$$

Substitute value of y in (iv)

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

$$-\frac{3}{x} + 8 = -1$$

$$-\frac{3}{x} = -1 - 8$$

$$-\frac{3}{x} = -9$$

$$X = \frac{3}{9}$$

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

Hence $x = \frac{1}{3}$ and $y = \frac{1}{4}$

(ii)

$$\frac{30}{x-y} + \frac{44}{x+y} = 10$$

$$\frac{40}{x-y} + \frac{55}{x+y} = 13$$

Solution :

$$\frac{30}{x-y} + \frac{44}{x+y} = 10 \dots(i)$$

$$\frac{40}{x-y} + \frac{55}{x+y} = 13 \dots(ii)$$

Multiply (i) by 4 and (ii) by 3, we get

$$\frac{120}{x-y} + \frac{176}{x+y} = 40 \dots(iii)$$

$$\frac{120}{x-y} + \frac{165}{x+y} = 39 \dots(iv)$$

Subtracting (iv) from (iii) we get

$$0 + \frac{11}{x+y} = 1$$

$$x + y = 11 \dots(v)$$

substituting (v) in (i) we get

$$\frac{30}{x-y} + \frac{44}{11} = 10$$

$$\frac{30}{x-y} + 4 = 10$$

$$\frac{30}{x-y} = 10 - 4$$

$$\frac{30}{x-y} = 6$$

$$X - y = \frac{30}{6}$$

$$X - y = 5 \dots(\text{vi})$$

Now solve for (v) and (vi)

$$X + y = 11$$

$$X - y = 5$$

Add (v) and (vi)

$$2x = 16$$

$$X = \frac{16}{2} = 8$$

Substitute x in (v)

$$8 + y = 11$$

$$Y = 11 - 8$$

$$Y = 3$$

Hence $x = 8$ and $y = 3$

4. (i) $ax + by = a - b$

$bx - ay = a + b$

solution

$ax + by = a - b \dots(i)$

$bx - ay = a + b \dots(ii)$

multiplying (i) by a and (ii) by b , we get

$a(ax + by) = a(a - b)$

$a^2x + aby = a^2 - ab \dots(iii)$

$b(bx - ay) = b(a + b)$

$b^2x - aby = ab + b^2 \dots(iv)$

adding (iii) and (iv)

$a^2x + aby = a^2 - ab$

$b^2x - aby = ab + b^2$

$(a^2 + b^2)x = (a^2 + b^2)$

$X = \frac{a^2 + b^2}{a^2 + b^2}$

$X = 1$

Substitute the value of x in (i) , we get

$a \times 1 + by = a - b$

$a + by = a - b$

$$by = -b$$

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

$$y = -1$$

hence $x = 1$ and $y = -1$

$$(ii) \quad 3x + 2y = 2xy$$

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

Solution

$$3x + 2y = 2xy$$

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

$$\frac{1}{x} + \frac{2}{y} = \frac{7}{6} \dots\dots(ii)$$

Divide (i) by xy

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

$$\frac{3}{y} + \frac{2}{x} = 2 \dots\dots(iii)$$

Multiply (ii) by 2 , we get

$$\frac{2}{x} + \frac{4}{y} = \frac{7}{3} \dots(\text{iv})$$

Subtract (iii) from (iv)

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

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

$$0 + \frac{1}{y} = \frac{7}{3} - 2$$

$$\frac{1}{y} = \frac{7-6}{3}$$

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

$$Y = 3$$

Substitute y in (iii)

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

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

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

$$X = 2$$

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

5 . solve $2x - \left(\frac{3}{y}\right) = 9$

$3x + \left(\frac{7}{y}\right) = 2$

Hence find the value of K if $x = ky + 5$

Solution

$2x - \left(\frac{3}{y}\right) = 9 \dots(i)$

$3x + \left(\frac{7}{y}\right) = 2 \dots (ii)$

Multiply (i) by 3 and (ii) by 2, we get

$6x - \left(\frac{9}{y}\right) = 27 \dots(iii)$

$6x + \left(\frac{14}{y}\right) = 4 \dots(iv)$

Subtracting (iv) from (iii) we get

$-\frac{23}{y} = 23$

$Y = \frac{23}{-23}$

$Y = -1$

Substitute y in (i)

$2x - \left(\frac{3}{-1}\right) = 9$

$2x + 3 = 9$

$2x = 9 - 3$

$2x = 6$

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

$$X = 3$$

Hence $x = 3$ and $y = -1$

Given $x = ky + 5$

Substitute x and y in above equation

$$3 = k \times -1 + 5$$

$$3 = -k + 5$$

$$K = 5 - 3$$

$$K = 2$$

Hence the value of k is 2

6. solve

$$\frac{1}{x+y} - \frac{1}{2x} = \frac{1}{30}$$

$$\frac{5}{x+y} + \frac{1}{3} = \frac{4}{3}$$

Hence find the value of $2x^2 - y^2$

Solution

$$\frac{1}{x+y} - \frac{1}{2x} = \frac{1}{30} \dots\dots(i)$$

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

Let $(x + y) = a$

$$\frac{1}{a} - \frac{1}{2x}$$

$$\frac{1}{a} - \frac{1}{2x} = \frac{1}{30} \dots\dots(\text{iii})$$

$$\frac{5}{a} + \frac{1}{x} = \frac{4}{3}$$

Multiply (iii) by 5

$$\frac{5}{a} - \frac{5}{2x} = \frac{1}{6} \dots\dots(\text{iv})$$

$$\frac{5}{a} + \frac{1}{x} = \frac{4}{3}$$

Subtracting (ii) from (iv)

$$-\frac{5}{2x} - \frac{1}{x} = \frac{1}{6} - \frac{4}{3}$$

$$\frac{-5-2}{2x} = \frac{1-8}{6}$$

$$-\frac{7}{2x} = -\frac{7}{6}$$

$$2x = 6$$

$$x = 3$$

Substituting x in (iii)

$$\frac{1}{a} - \frac{1}{2 \times 3} = \frac{1}{30}$$

$$\frac{1}{a} - \frac{1}{6} = \frac{1}{30}$$

$$\frac{1}{a} = \left(\frac{1}{30}\right) + \left(\frac{1}{6}\right)$$

$$\frac{1}{a} = \frac{1+5}{30}$$

$$\frac{1}{a} = \frac{6}{30}$$

$$a = \frac{30}{6}$$

$$a = 5$$

substitute a in $x + y = a$

$$3 + y = 5$$

$$Y = 5 - 3$$

$$Y = 2$$

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

$$2x^2 - y^2 = 2 \times 3^2 - 2^2$$

$$= 2 \times 9 - 4$$

$$= 18 - 4$$

$$= 14$$

Hence the value of $2x^2 - y^2$ is 14

7 . can x , y be found to satisfy the following equation simultaneously ?

$$\frac{2}{y} + \frac{5}{x} = 19$$

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

$$3x + 8y = 5$$

If so , find them

Solution

$$\frac{2}{y} + \frac{5}{x} = 19 \dots(i)$$

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

$$3x + 8y = 5 \dots(iii)$$

Multiply (i) by 5 and (ii) by 2 , we get

$$\frac{10}{y} + \frac{25}{x} = 95 \dots(iv)$$

$$\frac{10}{y} - \frac{6}{x} = 2 \dots(v)$$

Subtract (v) from (iv)

$$\frac{31}{x} = 95 - 2$$

$$\frac{31}{x} = 93$$

$$x = \frac{31}{93}$$

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

substitute x in (i)

$$\left(\frac{2}{y}\right) + 5 \div \left(\frac{1}{3}\right) = 19$$

$$\left(\frac{2}{y}\right) + 5 \times 3 = 19$$

$$\left(\frac{2}{y}\right) = 19 - 15$$

$$\left(\frac{2}{y}\right) = 4$$

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

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

Substitute x and y in (iii)

$$3 \times \left(\frac{1}{3}\right) + 8 \times \left(\frac{1}{2}\right) = 5$$

$$1 + 4 = 5$$

The value of x and y satisfies (iii)

Hence the given equations are simultaneous .