

Simultaneous Linear Equations

SIMULTANEOUS LINEAR EQUATIONS

Exercise 5.1

Solution - 18-

$$(i) \quad x + y = 14$$

$$x - y = 4$$

$$\therefore x + y = 14$$

$$x - y = 4$$

$$\therefore x = y + 4$$

$$x + y = 14$$

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

$$2y + 4 = 14$$

$$2y = 14 - 4$$

$$2y = 10$$

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

$$x + y = 14$$

$$x + 5 = 14$$

$$x = 14 - 5$$

$$x = 9$$

$$\therefore x = 9, y = 5$$

$$(ii) \quad s - t = 3 \quad \text{--- (1)}$$

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

$$2s + 3t = 6$$

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

$$\textcircled{1} \Rightarrow s - t = 3$$

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

$$3s - 6 - 2s = 9$$

$$s - 6 = 9$$

$$s = 6 + 9 \\ = 15$$

$$s - t = 3$$

$$15 - t = 3$$

$$-t = 3 - 15$$

$$+t = +12$$

$$t = 12$$

$$\therefore s = 15, t = 12.$$

g Solution -1

$$(iii) \quad 2x + 3y = 9 \quad \text{--- (1)}$$

$$3x + 4y = 5 \quad \text{--- (2)}$$

$$4y = 5 - 3x$$

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

$$\textcircled{1} \Rightarrow 2x + 3y = 9$$

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

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

$$-x = 36 - 15$$

$$-x = 21$$

$$x = -21$$

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

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

$$-42 + 3y = 9$$

$$3y = 9 + 42$$

$$3y = 51$$

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

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

$$\text{iv } 3x - 5y = 4 \quad \text{--- (1)}$$

$$9x - 2y = 7 \quad \text{--- (2)}$$

$$\textcircled{2} \quad 9x - 2y = 7$$

$$9x = 7 + 2y$$

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

$$3x - 5y = 4$$

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

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

$$-39y = 36 - 21$$

$$-39y = 15$$

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

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

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

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

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

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

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

$$x = \frac{27}{13} \cdot \frac{1}{3}$$

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

Solution - 2:-

$$(i) \quad a + 3b = 5 \quad \text{--- (1)}$$

$$7a - 8b = 6 \quad \text{--- (2)}$$

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

$$a + 3b = 5$$

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

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

$$6 + 29b = 35$$

$$29b = 35 - 6$$

$$29b = 29$$

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

$$b = 1$$

$$a + 3b = 5$$

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

$$a = 5 - 3$$

$$a = 2$$

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

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

$$x - 20 = 12y$$

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

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

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

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

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

$$64x - 128 = 0$$

$$64x = 128$$

$$x = 128/64$$

$$x = 2$$

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

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

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

$$6 + 4y = 0$$

$$4y = -6$$

$$y = \frac{-6}{4} = -3/2$$

$$\therefore x = 2, y = -3/2$$

Solution - 3

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

$$5x - 2y - 7 = 0 \quad \text{--- (2)}$$

$$8x = 12 + 3y$$

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

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

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

$$-y = 56 - 60$$

$$+y = +4$$

$$y = 4$$

$$\cancel{2x} + 5x - 2y - 7 = 0$$

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

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

$$5x - 15 = 0$$

$$5x = 15$$

$$x = 15/5$$

$$x = 3$$

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

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

$$5x - 20 = 8y$$

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

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

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

$$31x = 184 + 60$$

$$31x = 244$$

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

$$2x + 3y = 23$$

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

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

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

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

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

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

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

$$\therefore x = 7 \frac{27}{31} \quad y = 2 \frac{13}{31}$$

Solution - 4

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

$$x + y = 2m \quad - (ii)$$

substitute (ii) in (i)

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

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

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

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

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

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

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

$$\therefore y = m - n$$

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

$$= 2m - m + n$$

$$x = m + n$$

$$\therefore x = m + n$$

$$y = m - n$$

$$(ii) \frac{b}{a}x + \frac{a}{b}y = a^2 + b^2 \quad (10)$$

$$x + y = 2ab$$

$$\Rightarrow x = 2ab - y$$

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

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

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

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

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

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

$$y = ab$$

$$x = 2ab - y$$

$$x = 2ab - ab$$

$$= ab$$

⑤

$$2x + y = 35$$

$$3x + 4y = 65$$

$$3x + 4y = 65$$

$$4y = 65 - 3x$$

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

$$2x + y = 35$$

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

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

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

$$5x = 75$$

$$x = 15$$

$$2x + y = 35$$

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

$$30 + y = 35$$

$$y = 35 - 30$$

$$= 5$$

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

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

$$(6) \quad 3x - y = 5$$

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

$$3x = 5y + y$$

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

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

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

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

$$+5y = +23$$

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

$$3x - y = 5$$

$$3x - \frac{23}{5} = 5$$

$$3x - 23 = 25$$

$$3x = 25 + 23$$

$$3x = 48$$

$$x = \frac{48}{3} = 16$$

$$y = px - 3$$

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

$$\frac{23}{5} = \frac{16p}{3} - 15$$

$$\frac{23}{5} - 15 = \frac{16p}{3}$$

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

Exercise 5.2

Solution - 1:-

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

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

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

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

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

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

$$6+14y = 20$$

$$14y = 20-6$$

$$14y = 14$$

$$y = 1$$

$$\textcircled{1} \Rightarrow 3x + 4y = 10$$

$$3x = 10 - 4$$

$$3x = 6$$

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

$$x = 2$$

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

Ex ② $2x = 5y + 4$

(ii) $3x - 2y + 16 = 0$

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

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

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

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

$$11y + 44 = 0$$

$$11y = -44$$

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

$$y = -4$$

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

$$2x = -20 + 4$$

$$2x = -16$$

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

$$x = -8$$

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

Solution-2 :

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

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

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

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

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

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

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

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

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

$$\therefore y = 3$$

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

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

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

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

$$x = 4$$

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

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

$$\Rightarrow \quad 2x - 3y - 3 = 0$$

$$2x = 3y + 3$$

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

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

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

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

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

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

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

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

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

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

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

$$2x = \frac{30 - 9}{10}$$

$$x = \frac{21}{20} //$$

Solution- 3

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

$$14x - 15y = 115$$

$$\rightarrow 14x = 115 + 15y$$

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

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

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

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

$$29y = 1638 - 1725$$

$$29y = -87$$

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

$$y = -3$$

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

$$15x + 42 = 117$$

$$15x = 117 - 42$$

$$15x = 75$$

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

$$x = 5$$

$$(i) \quad 41x + 53y = 135$$

$$53x + 41y = 147$$

$$53x = 147 - 41y$$

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

$$41x + 53y = 135$$

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

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

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

$$1128y = 1128$$

$$y = \frac{1128}{1128}$$

$$y = 1$$

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

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

$$41x = 135 - 53$$

$$41x = 82$$

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

$$x = 2$$

Solution-4

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

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

$$\Rightarrow y = \frac{3x}{4} - 1$$

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

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

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

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

$$2x = 9x - 84$$

$$9x - 2x = 84$$

$$7x = 84$$

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

$$x = 12$$

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

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

$$y = 2 + 6$$

$$y = 8$$

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

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

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

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

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

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

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

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

$$11x + 14 = 40$$

$$11x = 40 - 14$$

$$11x = 26$$

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

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

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

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

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

Solution - 5

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

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

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

$$\Rightarrow 13 - x = y + 7$$

$$y = 13 - x - 7$$

$$y = 6 - x$$

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

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

$$12 = -14 + 3x$$

$$3x = 12 + 14$$

$$3x = 26$$

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

$$y = 6 - x$$

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

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

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

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

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

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

$$x - y = 3$$

$$x = 3 + y$$

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

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

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

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

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

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

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

$$x = 3 + y$$

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

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

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

Solution-6 :

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

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

$$33x - y = 136 \quad \dots (i)$$

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

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

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

$$y + 3x = 6 + 2$$

$$y + 3x = 8$$

$$y = 8 - 3x \quad \dots (ii)$$

Equ(ii) in equ (i)

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

$$36x = 136 + 8$$

$$36x = 144$$

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

$$x = 4$$

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

$$= 8 - 12$$

$$= -4$$

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

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

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

$$2x = 1-3y$$

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

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

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

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

Equ (ii) in equ (i)

$$\therefore 2(1-y) + 3y = 1$$

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

$$5y = 1-2$$

$$5y = -1$$

$$y = -1/5$$

$$\therefore x = y+1$$

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

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

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

Solution - 7

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

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

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

$$(or) \quad 6y = 13 - \frac{5}{x}$$

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

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

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

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

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

$$\frac{18 + 52x - 20}{6x} = 7$$

$$52x - 2 = 42x$$

$$52x - 42x = 2$$

$$10x = 2$$

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

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

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

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

$$y = \frac{\frac{13 - 25}{5}}{\frac{6}{5}}$$

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

$$y = -2$$

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

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

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

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

$$2) \quad 5 \left(\frac{3y - 1}{y} \right) - 9 = \frac{1}{y}$$

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

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

$$6y - 5 = 1$$

$$6y = 1 + 5$$

$$6y = 6$$

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

$$y = 1$$

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

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

$$x = 2$$

Solution - 8

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

$$qx - py = p + q$$

$$qx = p + q + py$$

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

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

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

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

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

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

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

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

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

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

$$y = -1$$

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

$$x = \frac{q + P(1-1)}{q}$$

$$x = \frac{q + P(0)}{q}$$

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

$$x = \frac{q}{q}$$

$$x = 1$$

$$\therefore x = 1$$

$$y = -1$$

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

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

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

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

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

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

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

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

$$y = b$$

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

$$\therefore x = a$$

Solution - 9 :-

18

$$\begin{aligned}\text{Given } 2x + y &= 23 \\ 4x - y &= 19\end{aligned}$$

$$\Rightarrow y = 23 - 2x$$

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

$$6x = 19 + 23$$

$$6x = 42$$

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

$$x = 7$$

$$\therefore y = 23 - 2x$$

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

$$y = 23 - 14$$

$$y = 9$$

$$\therefore x - 3y \Rightarrow 7 - 3(9) = 7 - 27 = -20$$

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

$$\therefore 5y - 2x \Rightarrow 5(9) - 2(7)$$

$$\Rightarrow 45 - 14$$

$$\Rightarrow 31$$

$$\therefore 5y - 2x = 31$$

Solution - 10 :

Given expression $ax + by$

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

$$\text{When } x = 2; y = 1$$

$$\therefore 2a + b = 7 \quad \text{--- (i)}$$

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

$$\text{When } x = -1, y = 1$$

$$-a + b = 1 \quad \text{--- (ii)}$$

$$\therefore b = 1 + a$$

$$\therefore 2a + 1 + a = 7$$

$$3a + 1 = 7$$

$$3a = 7 - 1$$

$$3a = 6$$

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

$$a = 2$$

$$b = 1 + a$$

$$b = 1 + 2$$

$$= 3$$

16)

Let the number be $xy(10x+y)$

reverse of that number $yx(10y+x)$

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

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

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

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

$$\Rightarrow x - 2y = 0 \quad \text{--- (1)}$$

and also given that $x+y=12$ --- (2)

on solving eq (1) and eq (2)

$$\text{(2) - (1)} \Rightarrow x+y - x+2y = 12$$

$$3y = 12$$

$$y = 4$$

Put $y=4$ in (1)

$$\Rightarrow x - 8 = 0$$

$$\Rightarrow x = 8$$

The required number is 84

17)

Let the number be $xy(10x+y)$ and reverse of number is $yx(10y+x)$

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

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

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

$$\Rightarrow 5x - 4y = 0 \quad \text{--- (1)}$$

And also given that $x-y=1$ --- (2)

Put $x=y+1$ in eq (1)

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

$$y = -5$$

Put $y=-5$ in eq (2)

$$\Rightarrow x = -4$$

The required number is 45

18)

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

Given that $x = 4z - ①$

$$x + y + z = 14 - ②$$

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

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

$$\Rightarrow 99x - 99z = 594$$

$$\Rightarrow 9x(x-z) = 594$$

$$\Rightarrow x - z = 6 - ③$$

on solving eq. ① & ③

$$4z - z = 6$$

$$3z = 6$$

$$\Rightarrow z = 2$$

Put $z = 2$ in eq. ③ $\Rightarrow x - 2 = 6$

$$\Rightarrow x = 8$$

Put $x = 8$ and $z = 2$ in eq. ② $\Rightarrow 8 + y + 2 = 14$

$$\Rightarrow y = 4$$

\therefore The required number is 842

19)

Let the age of manna and her daughter, be 'm' and 'd'

Given that

$$m - 4 = 3(d - 4) - ①$$

$$m + 6 = 2(d + 6) - ②$$

eq. ① $\Rightarrow m - 4 = 3d - 12$

$$\Rightarrow m = 3d - 8 - ③$$

eq. ② $\Rightarrow m + 6 = 2d + 12$

$$\Rightarrow m = 2d + 6 - ④$$

from ③ & ④ $3d - 8 = 2d + 6$
 $d = 14$

Put $d = 14$ in eq. ④

$$m = 2d + 6 = 34$$

$$m = 34$$

\therefore The present age of manna and her daughter is 34 and 14.

$$\begin{aligned} \text{ex. ①} \times 12 &\Rightarrow 144x + 120y = 156000 \\ \text{ex. ②} \times 10 &\Rightarrow \underline{100x + 120y = 134000} \\ \hline 44x &= 22000 \end{aligned}$$

$$x = 5000$$

Put $x = 5000$ in ex. ②

$$60000 + 10y = 130000$$

$$10y = 70000$$

$$y = 7000$$

Thus the money invested at 12% is 5000/-
10% is 7000/-

22)

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%

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

and given that $\frac{108x}{100} + \frac{90y}{100} = 1028$

$$\Rightarrow 6x + 5y = 5600 \quad \text{--- (1)}$$

Case-(ii)

Table is sold at a profit of 10%

$$\therefore \text{S.P. of table} = x + \frac{10x}{100} = \frac{110x}{100}$$

Chair is sold at a discount of 8%

$$\therefore \text{S.P. of chair} = y - \frac{8y}{100} = \frac{92y}{100}$$

Given that

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

$$\Rightarrow 110x + 92y = 102800 \quad \text{--- (2)}$$

on solving eq (1) + eq (2) $x = 600, y = 400$

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

ex. ① - ex. ② $y=5$

Put $y=5$ in ①
 $\Rightarrow x-10=2$
 $\Rightarrow x=12.$

\therefore No. of students in the class is $12 \times 5 = 60.$

25)

Let 'x' grams of 18 carat gold is added, then the amount of 12 carat gold added is $(120-x)$ grams

Given Purity of gold is 24 carat

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

$$\Rightarrow 18x + 12(120-x) = 120 \times 16$$

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

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

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

\therefore 80 grams of 18 carat gold added with $120-80=40$ grams of 12 carat gold.

26)

Given A and B both can do work in 15 days.

(A+B) one day's work = $\frac{1}{15}$

$$\frac{\text{A's 1 day's work}}{\text{B's 1 day's work}} = \frac{\frac{3}{2}}{1} = \frac{3}{2}$$

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

Then $3x+2x = \frac{1}{15}$

$$5x = \frac{1}{15}$$

$$\Rightarrow x = \frac{1}{75}$$

$$\text{A's 1 day work} = 3x \cdot \frac{1}{75} = \frac{1}{25}$$

$$\text{B's 1 day work} = 2x \cdot \frac{1}{75} = \frac{1}{37.5}$$

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

27)

Let a man's rate be 'm':
women's rate be 'w'

Given $2m + 5w = \frac{1}{4}$
 $m + w = \frac{1}{12}$

$$\Rightarrow 8m + 20w = 1 \quad \text{--- (1)}$$

$$\Rightarrow 12m + 12w = 1 \quad \text{--- (2)}$$

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

$$\text{Eq. (2)} \times 2 \Rightarrow 24m + 24w = 2$$

$$\hline 36w = 1$$

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

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

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

1 man would take 18 days to complete the work.

28)

Let the due speed of train be 'x' kmph and scheduled time be 'y' hr.
Therefore length of the journey = xy km.

Given

$$(i) (x+30)(y-2) = xy$$

$$\Rightarrow xy - 2x + 30y - 60 = xy$$

$$\Rightarrow 2x - 30y + 60 = 0 \quad \text{--- (1)}$$

$$(ii) (x-15)(y+2) = xy$$

$$xy + 2x - 15y - 30 = xy$$

$$2x - 15y - 30 = 0 \quad \text{--- (2)}$$

$$\text{Eq. (2)} - \text{Eq. (1)} \Rightarrow 15y - 90 = 0$$

$$\Rightarrow 15y = 90$$

$$\Rightarrow y = 6 \text{ hr}$$

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

$$2x = 120$$

$$x = 60 \text{ kmph}$$

\(\therefore\) The length of the journey is $60 \times 6 = 360$ km.

29)

Let speed of boat in still water be 'x' kmph

" current be 'y' kmph

Time to go with the current is 2 hrs

$$\Rightarrow \frac{40}{x+y} = 2$$

$$\Rightarrow x+y = 20 \quad \text{--- (1)}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

Time to go against the current is 4 hrs

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

$$\Rightarrow x-y = 10 \quad \text{--- (2)}$$

$$\text{e. (1) + (2)} \Rightarrow 2x = 30$$

$$x = 15$$

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

$$\Rightarrow y = 5$$

∴ speed of boat in still water and speed of current is 15 kmph & 5 kmph

30)

Let the speed of boat in still water be 'x' kmph

" current be 'y' kmph

Time to go with the current is 4 hrs

$$\Rightarrow \frac{44}{x+y} = 4$$

$$\Rightarrow x+y = 11 \quad \text{--- (1)}$$

Time to go against the current is 4 hr. 48 min

$$= 288 \text{ min}$$

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

$$\left[\frac{288 \text{ min}}{60} \right]$$

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

$$\Rightarrow 6x - 6y = 55 \quad \text{--- (2)}$$

$$\text{e. (2) + e. (1) \times 6} \Rightarrow 12x = 121$$

$$\Rightarrow x = \frac{121}{12} \text{ kmph. --- speed of boat in still water}$$

$$\text{Put } x = \frac{121}{12} \text{ in (1)} \Rightarrow y = 11 - \frac{121}{12}$$

$$y = \frac{11}{12} \text{ kmph. --- speed of current}$$

31)

Let the plane air speed be 'x' kmph and wind speed be 'y' kmph

And given that with a head wind it took 3.5 hrs

$$\Rightarrow \frac{240}{x-y} = 3.5 = \frac{7}{2}$$

$$\Rightarrow x-y = 480 \text{ --- (1)}$$

On return it took 3 hrs

$$\Rightarrow \frac{560}{x+y} = 3$$

$$\Rightarrow x+y = 560 \text{ --- (2)}$$

$$\text{(1) + (2)} \Rightarrow 2x = 1040$$

$$x = 520$$

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

$$\Rightarrow y = 40$$

\(\therefore\) plane air speed is 520 kmph and wind speed 40 kmph.

32)

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

Given that Bhawana paid 2600 for 20 days

$$\Rightarrow x + 20y = 2600 \text{ --- (1)}$$

and Divya paid 3020 for 26 days

$$\Rightarrow x + 26y = 3020 \text{ --- (2)}$$

$$\text{eq. (2) - eq. (1)} \Rightarrow 6y = 420$$

$$y = 70$$

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

$$\Rightarrow x + 1400 = 2600$$

$$\Rightarrow x = 1200$$

\(\therefore\) fixed charges - 1200/-

cost of food per day - 70/-