**4.** Find the values of each of the following determinants.

(1) $\begin{vmatrix} 4 & 3 \\ 2 & 7 \end{vmatrix}$

Soln:-

$$\begin{vmatrix} 4 & 3 \\ 2 & 7 \end{vmatrix}$$

$$= (4 \times 7) - (2 \times 3)$$

$$= 28 - 6$$

$$= 22$$

(2) $\begin{vmatrix} 5 & -2 \\ -3 & 1 \end{vmatrix}$

Soln:-

$$\begin{vmatrix} 5 & -2 \\ -3 & 1 \end{vmatrix}$$

$$= (5 \times 1) - (-2 \times -3)$$

$$= 5 - 6$$

$$= -1$$

(3) $\begin{vmatrix} 3 & -1 \\ 1 & 4 \end{vmatrix}$

Soln:- $\begin{vmatrix} 3 & -1 \\ 1 & 4 \end{vmatrix}$

$= (3 \times 4) - (1 \times -1)$

$= 12 - (-1)$

$= 12 + 1$

$= 13$

**5.** Solve the following equations by Cramer's method.

(1) $6x - 3y = -10$ ; $3x + 5y - 8 = 0$

Soln:- $6x - 3y = -10$ — (I)

$3x + 5y - 8 = 0$

$\therefore \quad 3x + 5y = 8$ — (II)

$\therefore \quad D = \begin{vmatrix} 6 & -3 \\ 3 & +5 \end{vmatrix}$

$= (6 \times 5) - (3 \times -3)$

$= 30 - (-9)$

$= 30 + 9$

$\therefore$ $\boxed{D = 39}$

And,

$$Dx = \begin{vmatrix} -10 & -3 \\ 8 & 5 \end{vmatrix}$$

$$= (-10 \times 5) - (-3 \times 8)$$

$$= -50 - (-24)$$

$$= -50 + 24$$

$\therefore$ $\boxed{Dx = -26}$

Also,

$$Dy = \begin{vmatrix} 6 & -10 \\ 3 & 8 \end{vmatrix}$$

$$= (6 \times 8) - (3 \times -10)$$

$$= 48 - (-30)$$

$$= 48 + 30$$

$\boxed{Dy = 78}$

Now, $x = \frac{Dx}{D}$

$= \frac{-26}{39}$

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

And, $y = \frac{Dy}{D}$

$= \frac{78}{39}$

$\therefore \boxed{y = 2}$

$\therefore$ Solution $= (x, y) = \left(\frac{-2}{3}, 2\right)$

(2) $4m - 2n = -4$ ; $4m + 3n = 16$

Soln:-

$4m - 2n = -4$ — (I)

$4m + 3n = 16$ — (II)

Now,

$$D = \begin{vmatrix} 4 & -2 \\ 4 & 3 \end{vmatrix}$$

$= (4 \times 3) - (4 \times -2)$

$= 12 - (-8)$

$= 12 + 8$

$\therefore \boxed{D = 20}$

And,

$$D_x = \begin{vmatrix} -4 & -2 \\ 16 & 3 \end{vmatrix}$$

$= (-4 \times 3) - (-2 \times 16)$

$= -12 - (-32)$

$= -12 + 32$

$\boxed{D_x = 20}$

Also,

$$D_y = \begin{vmatrix} 4 & -4 \\ 4 & 16 \end{vmatrix}$$

$= (4 \times 16) - (4 \times -4)$

$= 64 - (-16)$

$= 64 + 16$

$\therefore \boxed{D_y = 80}$

$\therefore \quad x = \frac{D_x}{D}$

$= \frac{20}{20}$

$\therefore \boxed{x = 1}$

& $\quad y = \frac{D_y}{D}$

$= \frac{80}{20}$

$\therefore \boxed{y = 4}$

$\therefore$ Solution $= (x, y) = (1, 4)$.

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

Soln:-

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

Multiply both sides by 2,

$\therefore \quad 2 \times 3x - 2 \times 2y = \frac{5}{2} \times 2$

$\therefore \quad 6x - 4y = 5 \quad - (I)$

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

Multiply both sides by 3,

$$\therefore \quad \frac{1}{3}x \times 3 + 3y \times 3 = \frac{-4}{3} \times 3$$

$$\therefore \quad x + 9y = -4 \quad \text{— (II)}$$

Now,

$$D = \begin{vmatrix} 6 & -4 \\ 1 & 9 \end{vmatrix}$$

$$= (6 \times 9) - (1 \times -4)$$

$$= 54 - (-4)$$

$$= 54 + 4$$

$$\therefore \boxed{D = 58}$$

And,

$$Dx = \begin{vmatrix} 5 & -4 \\ -4 & 9 \end{vmatrix}$$

$$= (5 \times 9) - (-4 \times -4)$$

$$= 45 - 16$$

$\therefore \quad \boxed{D_x = 29}$

Also, $$D_y = \begin{vmatrix} 6 & 5 \\ 1 & -4 \end{vmatrix}$$

$$= (6 \times -4) - (1 \times 5)$$

$$= -24 - 5$$

$$\boxed{D_y = -29}$$

Now, $$x = \frac{D_x}{D}$$

$$= \frac{29}{58}$$

$\therefore \quad \boxed{x = \frac{1}{2}}$

And, $$y = \frac{D_y}{D}$$

$$= \frac{-29}{58}$$

$\therefore \quad \boxed{y = \frac{-1}{2}}$

$\therefore$ Solution $= (x, y) = \left(\frac{1}{2}, \frac{-1}{2}\right)$

(4) $7x + 3y = 15 \; ; \; 12y - 5x = 39$

Soln:-

$$7x + 3y = 15 \quad - (I)$$

$$12y - 5x = 39$$

$$\therefore \quad -5x + 12y = 39 \quad - (II)$$

Now,

$$D = \begin{vmatrix} 7 & 3 \\ -5 & 12 \end{vmatrix}$$

$$= (7 \times 12) - (3 \times -5)$$

$$= 84 - (-15)$$

$$= 84 + 15$$

$$\boxed{D = 99}$$

And,

$$Dx = \begin{vmatrix} 15 & 3 \\ 39 & 12 \end{vmatrix}$$

$$= (15 \times 12) - (3 \times 39)$$

$$= 180 - 117$$

$$\therefore \quad \boxed{D_x = 63}$$

Also,

$$D_y = \begin{vmatrix} 7 & 15 \\ -5 & 39 \end{vmatrix}$$

$$= (7 \times 39) - (-5 \times 15)$$

$$= 273 - (-75)$$

$$= 273 + 75$$

$$\therefore \quad \boxed{D_y = 348}$$

Now,

$$x = \frac{Dx}{D}$$

$$= \frac{63}{99}$$

$$= \frac{7 \times 9}{11 \times 9}$$

$$\therefore \quad \boxed{x = \frac{7}{11}}$$

Also,

$$y = \frac{Dy}{D}$$

$$= \frac{348}{99}$$

$$= \frac{3 \times 116}{3 \times 33}$$

$$\therefore \boxed{y = \frac{116}{33}}$$

$\therefore$ The solution is,

$$(x, y) = \left(\frac{7}{11}, \frac{116}{33}\right)$$

(5) $\dfrac{x+y-8}{2} = \dfrac{x+2y-14}{3} = \dfrac{3x-y}{4}$

Soln:-

$$\frac{x+y-8}{2} = \frac{x+2y-14}{3}$$

$$\therefore 3(x+y-8) = 2(x+2y-14)$$

$$\therefore 3x+3y-24 = 2x+4y-28$$

$$\therefore 3x+3y-2x-4y = -28+24$$

$$\therefore \quad x - y = -4 \quad \text{—— (I)}$$

Now,

$$\frac{x + 2y - 14}{3} = \frac{3x - y}{4}$$

$$\therefore \quad 4(x + 2y - 14) = 3(3x - y)$$

$$\therefore \quad 4x + 8y - 56 = 9x - 3y$$

$$\therefore \quad 4x + 8y - 9x + 3y = 56$$

$$\therefore \quad -5x + 11y = 56 \quad \text{—— (II)}$$

$$\therefore \quad D = \begin{vmatrix} 1 & -1 \\ -5 & 11 \end{vmatrix}$$

$$= (1 \times 11) - (-1 \times -5)$$

$$= 11 - 5$$

$$\therefore \quad \boxed{D = 6}$$

And,

$$D_x = \begin{vmatrix} -4 & -1 \\ 56 & 11 \end{vmatrix}$$

$$= (-4 \times 11) - (56 \times -1)$$

$$= -44 - (-56)$$

$$= -44 + 56$$

$$\boxed{D_x = 12}$$

Also,

$$D_y = \begin{vmatrix} 1 & -4 \\ -5 & 56 \end{vmatrix}$$

$$= (1 \times 56) - (-5 \times -4)$$

$$= 56 - 20$$

$$\boxed{D_y = 36}$$

Now,

$$x = \frac{Dx}{D}$$

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

$$\therefore \boxed{x = 2}$$

Also,

$$y = \frac{D_y}{D}$$

$$= \frac{36}{6}$$

$$\therefore \boxed{y = 6}$$

$\therefore$ The solution is,

$$(x, y) = (2, 6)$$

**6.** Solve the following simultaneous equations.

(1) $\frac{2}{x} + \frac{2}{3y} = \frac{1}{6}$ ; $\frac{3}{x} + \frac{2}{y} = 0$

Soln:- Let, $\frac{1}{x} = m$ & $\frac{1}{y} = n$,

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

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

$$\therefore 2m + \frac{2}{3}n = \frac{1}{6}$$

Multiply both sides by 6,

$$\therefore 6 \times 2m + 6 \times \frac{2}{3}n = 6 \times \frac{1}{6}$$

$$\therefore \quad 12m + 4n = 1 \quad \text{---} \quad (I)$$

Now, $\frac{3}{x} + \frac{2}{y} = 0$

$$\therefore \quad 3 \times \frac{1}{x} + 2 \times \frac{1}{y} = 0$$

$$\therefore \quad 3m + 2n = 0$$

Multiply both sides by 2,

$$\therefore \quad 2 \times 3m + 2 \times 2n = 2 \times 0$$

$$\therefore \quad 6m + 4n = 0 \quad \text{---} \quad (II)$$

Substract eq? (II) from eq? (I),

$$\begin{array}{r} 12m + 4n = 1 \\ - \quad 6m + 4n = 0 \\ \hline 6m \qquad = 1 \end{array}$$

$$\therefore \quad \boxed{m = \frac{1}{6}}$$

Put $m = \frac{1}{6}$ in eq? (I),

$$12m + 4n = 1$$

$\therefore \quad 12 \times \frac{1}{6} + 4n = 1$

$\therefore \quad 2 + 4n = 1$

$\therefore \quad 4n = 1 - 2$

$\therefore \quad 4n = -1$

$\therefore \quad \boxed{n = \frac{-1}{4}}$

But, $m = \frac{1}{x}$ & $n = \frac{1}{y}$

$\therefore \quad \frac{1}{6} = \frac{1}{x}$ & $\frac{-1}{4} = \frac{1}{y}$

$\therefore \quad \boxed{x = 6}$ & $\boxed{y = -4}$

$\therefore$ The solution is,

$(x, y) = (6, -4)$.

(2) $\frac{7}{2x+1} + \frac{13}{y+2} = 27 \; ; \; \frac{13}{2x+1} + \frac{7}{y+2} = 33$

Soln:- Let,

$$\frac{1}{2x+1} = m \quad \& \quad \frac{1}{y+2} = n$$

$$\therefore \quad \frac{7}{2x+1} + \frac{13}{y+2} = 27$$

$$\therefore \quad 7 \times \frac{1}{2x+1} + 13 \times \frac{1}{y+2} = 27$$

$$\therefore \quad 7m + 13n = 27 \quad \text{— (I)}$$

Also,

$$\frac{13}{2x+1} + \frac{7}{y+2} = 33$$

$$\therefore \quad 13 \times \frac{1}{2x+1} + 7 \times \frac{1}{y+2} = 33$$

$$\therefore \quad 13m + 7n = 33 \quad \text{— (II)}$$

Add eq? (I) & eq? (II),

$$\begin{array}{r} 7m + 13n = 27 \\ + \quad 13m + 7n = 33 \\ \hline 20m + 20n = 60 \end{array}$$

$$\therefore \quad \frac{20m}{20} + \frac{20n}{20} = \frac{60}{20}$$

$$\therefore \quad m + n = 3 \quad \text{— (III)}$$

Substract eq? (I) from eq? (II),

$$\begin{array}{r} 13m + 7n = 33 \\ - \quad 7m + 13n = 27 \\ \hline 6m - 6n = 6 \end{array}$$

$$\therefore \quad \frac{6m}{6} - \frac{6n}{6} = \frac{6}{6}$$

$$\therefore \quad m - n = 1 \quad \text{— (IV)}$$

Add eq? (III) & eq? (IV),

$$\begin{array}{r} m + n = 3 \\ + \quad m - n = 1 \\ \hline 2m = 4 \end{array}$$

$$\therefore \quad m = \frac{4}{2}$$

$$\therefore \quad \boxed{m = 2}$$

Put $m = 2$ in eq$^{n}$ (III),

$\therefore \quad m + n = 3$

$\therefore \quad 2 + n = 3$

$\therefore \quad n = 3 - 2$

$\therefore \quad \boxed{n = 1}$

But,

$$m = \frac{1}{2x+1} \quad \& \quad n = \frac{1}{y+2}$$

$$\therefore \quad 2 = \frac{1}{2x+1} \quad \& \quad 1 = \frac{1}{y+2}$$

$$\therefore \quad 2x+1 = \frac{1}{2} \quad \& \quad y+2 = 1$$

$$\therefore \quad 2(2x+1) = 1 \quad \& \quad y = 1-2$$

$$\therefore \quad 4x + 2 = 1 \quad \& \quad \boxed{y = -1}$$

$$\therefore \quad 4x = 1 - 2$$

$$\therefore \quad 4x = -1$$

$\therefore$ $\boxed{x = \frac{-1}{4}}$

$\therefore$ The solution is,

$$(x, y) = \left(\frac{-1}{4}, -1\right)$$

(3) $\frac{148}{x} + \frac{231}{y} = \frac{527}{xy}$ ; $\frac{231}{x} + \frac{148}{y} = \frac{610}{xy}$

Soln:-

$$\frac{148}{x} + \frac{231}{y} = \frac{527}{xy}$$

$\therefore$ $$\frac{148y + 231x}{xy} = \frac{527}{xy}$$

$\therefore$ $$231x + 148y = 527 \quad -(I)$$

Also,

$$\frac{231}{x} + \frac{148}{y} = \frac{610}{xy}$$

$\therefore$ $$\frac{231y + 148x}{xy} = \frac{610}{xy}$$

$\therefore$ $$148x + 231y = 610 \quad -(II)$$

Add eq? (I) & eq? (II),

$$\begin{array}{rrcl} & 231x + 148y & = & 527 \\ + & 148x + 231y & = & 610 \\ \hline & 379x + 379y & = & 1137 \end{array}$$

$$\therefore \quad \frac{379x}{379} + \frac{379y}{379} = \frac{1137}{379}$$

$$\therefore \quad x + y = 3 \quad \text{—} \quad (III)$$

Substract eq? (I) from eq? (II),

$$\begin{array}{rrcl} & 148x + 231y & = & 610 \\ - & 231x + 148y & = & 527 \\ \hline & -83x + 83y & = & 83 \end{array}$$

$$\therefore \quad \frac{-83x}{83} + \frac{83y}{83} = \frac{83}{83}$$

$$\therefore \quad -x + y = 1 \quad \text{—} \quad (IV),$$

Add eq? (III) & eq? (IV),

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

$$2y = 4$$

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

$$\therefore \quad \boxed{y = 2}$$

Put $y = 2$ in eq? (III),

$$x + y = 3$$

$$\therefore \quad x + 2 = 3$$

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

$$\therefore \quad \boxed{x = 1}$$

$\therefore$ The solution is,

$$(x, y) = (1, 2)$$

(4) $\frac{7x-2y}{xy} = 5 \quad ; \quad \frac{8x+7y}{xy} = 15$

Soln:-

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

$\therefore \quad 7x - 2y = 5xy$

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

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

$\therefore \quad \frac{-2}{x} + \frac{7}{y} = 5 \quad - (I)$

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

$\therefore \quad 8x + 7y = 15xy$

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

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

$\therefore \quad \frac{7}{x} + \frac{8}{y} = 15 \quad - (II)$

Let, $\frac{1}{x} = m \quad \& \quad \frac{1}{y} = n$

$\therefore$ Eq$^n$ (I) becomes,

$\therefore \quad -2m + 7n = 5$

Multiply both sides by 7,

$\therefore \quad 7 \times -2m + 7 \times 7n = 7 \times 5$

$\therefore \quad -14m + 49n = 35 \quad \text{— (III)}$

And, Eq? (II) becomes,

$7m + 8n = 15$

Multiply both sides by 2,

$\therefore \quad 7m \times 2 + 8n \times 2 = 15 \times 2$

$\therefore \quad 14m + 16n = 30 \quad \text{— (IV)}$

Add eq? (III) & eq? (IV),

$$\begin{array}{rl} & -14m + 49n = 35 \\ + & 14m + 16n = 30 \\ \hline & 65n = 65 \end{array}$$

$\therefore \quad n = \frac{65}{65}$

$\therefore \quad \boxed{n = 1}$

Put $n = 1$ in eq? (III),

$$-14m + 49n = 35$$

$$\therefore \quad -14m + (49 \times 1) = 35$$

$$\therefore \quad -14m + 49 = 35$$

$$\therefore \quad -14m = 35 - 49$$

$$\therefore \quad +14m = +14$$

$$\therefore \quad m = \frac{14}{14}$$

$$\therefore \quad \boxed{m = 1}$$

But,

$$m = \frac{1}{x} \quad \& \quad n = \frac{1}{y}$$

$$\therefore \quad 1 = \frac{1}{x} \quad \& \quad 1 = \frac{1}{y}$$

$$\therefore \quad \boxed{x = 1} \quad \& \quad \boxed{y = 1}$$

$\therefore$ The solution is,

$$(x, y) = (1, 1)$$

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

Soln:- Let,

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

Now,

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

$$\therefore \quad \frac{1}{2} \times \frac{1}{3x+4y} + \frac{1}{5} \times \frac{1}{2x-3y} = \frac{1}{4}$$

$$\therefore \quad \frac{1}{2}m + \frac{1}{5}n = \frac{1}{4}$$

Multiply both sides by 20,

$$\therefore \quad 20 \times \frac{1}{2}m + 20 \times \frac{1}{5}n = \frac{1}{4} \times 20$$

$$\therefore \quad 10m + 4n = 5 \quad \text{---} \quad (I)$$

Also,

$$\frac{5}{3x+4y} - \frac{2}{2x-3y} = \frac{-3}{2}$$

$$\therefore \quad 5 \times \frac{1}{3x+4y} - 2 \times \frac{1}{2x-3y} = -\frac{3}{2}$$

$$\therefore \quad 5m - 2n = -\frac{3}{2}$$

Multiply both sides by 2,

$$\therefore \quad 2 \times 5m - 2 \times 2n = -\frac{3}{2} \times 2$$

$$\therefore \quad 10m - 4n = -3 \quad \text{—— (II)}$$

Add eq? (I) & eq? (II),

$$\begin{array}{r} 10m + 4n = 5 \\ + \\ 10m - 4n = -3 \\ \hline 20m \qquad = 2 \end{array}$$

$$\therefore \quad m = \frac{2}{20}$$

$$\therefore \quad \boxed{m = \frac{1}{10}}$$

Put $m = \frac{1}{10}$ in eq? (I),

$$10m + 4n = 5$$

$$\therefore \quad 10 \times \frac{1}{10} + 4n = 5$$

$$\therefore \quad 1 + 4n = 5$$

$$\therefore \quad 4n = 5 - 1$$

$$\therefore \quad 4n = 4$$

$$\therefore \quad n = \frac{4}{4}$$

$$\therefore \quad \boxed{n = 1}$$

But,

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

$$\therefore \quad \frac{1}{10} = \frac{1}{3x+4y} \quad \& \quad 1 = \frac{1}{2x-3y}$$

$$\therefore \quad 3x + 4y = 10 \quad -(III) \quad \&$$

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

Multiply both sides of eq$^{n}$. (III) by 3,

$$\therefore \quad 3 \times 3x + 3 \times 4y = 3 \times 10$$

$$\therefore \quad 9x + 12y = 30 \quad -(V)$$

& Multiply both sides of eq$^{n}$. (V) by 4,

$$\therefore \quad 4 \times 2x - 4 \times 3y = 4 \times 1$$

$$\therefore \quad 8x - 12y = 4 \quad -(VI)$$

Now, Add eq? (V) & eq? (VI),

$$9x + 12y = 30$$
$$+ \quad 8x - 12y = 4$$
$$\overline{17x \qquad = 34}$$

$$\therefore \quad x = \frac{34}{17}$$

$$\therefore \quad \boxed{x = 2}$$

Put $x = 2$ in eq? (III),

$$3x + 4y = 10$$

$$\therefore \quad (3 \times 2) + 4y = 10$$

$$\therefore \quad 6 + 4y = 10$$

$$\therefore \quad 4y = 10 - 6$$

$$\therefore \quad 4y = 4$$

$$\therefore \quad y = \frac{4}{4}$$

$$\therefore \quad \boxed{y = 1}$$

$\therefore$ The solution is,

$$(x, y) = (2, 1).$$

**7.** Solve the following word problems.

(1) A two digit number and the number with digits interchanged add up to 143. In the given number the digit in unit's place is 3 more than the digit in the ten's place. Find the original number.

Let the digit in unit's place is $x$

and that in the ten's place is $y$

$\therefore$ the number = $10\,y + x$

The number obtained by interchanging the digits is $10\,x + y$

According to first condition two digit number + the number obtained by interchanging the digits = 143 → $10x+y$

$\therefore \quad 10y + x + \square = 143$

$\therefore \quad 11x + 11y = 143$

$x + y = 13 \quad \ldots\ldots$ (I)

From the second condition,

digit in unit's place = digit in the ten's place + 3

$\therefore \quad x = y + 3$

$\therefore \quad x - y = 3 \quad \ldots\ldots$ (II)

Adding equations (I) and (II)

$2x = 16$

$x = 8$

Putting this value of $x$ in equation (I)

$x + y = 13$

$8 + y = 13$

$\therefore \quad y = 5$

The original number is $10y + x = (10 \times 5) + 8$

$= 50 + 8$

$= 58$

(2) Kantabai bought $1\frac{1}{2}$ kg tea and 5 kg sugar from a shop. She paid ₹ 50 as return fare for rickshaw. Total expense was ₹ 700. Then she realised that by ordering online the goods can be bought with free home delivery at the same price. So next month she placed the order online for 2 kg tea and 7 kg sugar. She paid ₹ 880 for that. Find the rate of sugar and tea per kg.

Soln:- Let, the rate of sugar per kg be '$x$' rupees and the rate of tea per kg be '$y$' rupees.

Now, Kantabai bought $1\frac{1}{2}$ kg tea & 5 kg sugar and also paid 50 rupees fare for rickshaw. Total expense was ₹ 700.

$$\therefore \quad 1\frac{1}{2}x + 5y + 50 = 700$$

$$\therefore \quad \frac{3}{2}x + 5y = 700 - 50$$

$$\therefore \quad \frac{3}{2}x + 5y = 650$$

Multiply both sides by 2,

$$\therefore \quad 2 \times \frac{3}{2}x + 2 \times 5y = 2 \times 650$$

$$\therefore \quad 3x + 10y = 1300 \quad -(I)$$

Also, next month she bought 2 kg tea & 7 kg sugar for ₹ 880.

$$\therefore \quad 2x + 7y = 880 \quad -(II)$$

Multiply eq? (I) by 2, we get,

$$2 \times 3x + 2 \times 10y = 2 \times 1300$$

$$\therefore \quad 6x + 20y = 2600 \quad -(III)$$

& Multiply eq? (II) by 3, we get,

$$\therefore \quad 3 \times 2x + 3 \times 7y = 3 \times 880$$

$$\therefore \quad 6x + 21y = 2640 \quad -(IV)$$

Substract eq? (III) from eq? (IV),

$$\begin{array}{rrrr} & 6x & + 21y & = 2640 \\ - & 6x & + 20y & = 2600 \\ \hline & & y & = 40 \end{array}$$

$$\therefore \quad \boxed{y = 40}$$

Put $y = 40$ in eq? (II),

$$2x + 7y = 880$$

$$\therefore \quad 2x + (7 \times 40) = 880$$

$$\therefore \quad 2x + 280 = 880$$

$$\therefore \quad 2x = 880 - 280$$

$$\therefore \quad 2x = 600$$

$\therefore \quad x = \frac{600}{2}$

$\therefore \quad \boxed{x = 300}$

$\therefore$ The rate of tea = ₹ 300/kg.

& the rate of sugar = ₹ 40/kg.

(3) To find number of notes that Anushka had, complete the following activity.

Suppose that Anushka had [x] notes of ₹ 100 and [y] notes of ₹ 50 each

Anushka got ₹ 2500/- from Anand as denominations mentioned above
$\therefore$ ..... equation I

$\therefore$ The No. of notes ( , )

If Anand would have given her the amount by interchanging number of notes, Anushka would have received ₹ 500 less than the previous amount
$\therefore$ ..... equation II

Soln:- Let, Anushka had 'x' notes of ₹ 100 and 'y' notes of ₹ 50 each.

Now, Anushka got ₹ 2500 from Anand as denominations mentioned above.

$\therefore \quad 100x + 50y = 2500$

$\therefore \quad \frac{100x}{50} + \frac{50y}{50} = \frac{2500}{50}$

$\therefore \quad 2x + y = 50 \quad \text{— (I)}$

Also, if the denominations are interchanged, she would get ₹ 500 less.

$\therefore \quad 100y + 50x = 2500 - 500$

$\therefore \quad 100y + 50x = 2000$

$\therefore \quad \frac{100y}{50} + \frac{50x}{50} = \frac{2000}{50}$

$\therefore \quad 2y + x = 40 \quad \text{— (II)}$

Multiply eq? (II) by 2,

$\therefore \quad 2 \times 2y + 2 \times x = 2 \times 40$

$\therefore \quad 4y + 2x = 80$

$\therefore \quad 2x + 4y = 80 \quad \text{— (III)}$

Substract eq? (I) from eq? (III),

$$\begin{array}{rrrr} & 2x & + 4y & = 80 \\ - & 2x & + y & = 50 \\ \hline & & 3y & = 30 \end{array}$$

$\therefore \quad y = \frac{30}{3}$

$\therefore$ $\boxed{y = 10}$

Put $y = 10$ in eqn: (I),

$\therefore$ $2x + y = 50$

$\therefore$ $2x + 10 = 50$

$\therefore$ $2x = 50 - 10$

$\therefore$ $2x = 40$

$\therefore$ $x = \frac{40}{2}$

$\therefore$ $\boxed{x = 20}$

$\therefore$ The number of notes of rupees 100 are 20 & the number of notes of rupees 50 are 10.

(4) Sum of the present ages of Manish and Savita is 31. Manish's age 3 years ago was 4 times the age of Savita. Find their present ages.

Soln:- Let, the present age of Manish be 'x' years and the present age of Savita be 'y' years.

Now, the sum of present ages of Manish and Savita is 31.

$$\therefore \quad x + y = 31 \quad \text{—— (I)}$$

Also, Manish's age 3 years ago was 4 times the age of Savita.

$$\therefore \quad (x - 3) = 4(y - 3)$$

$$\therefore \quad x - 3 = 4y - 12$$

$$\therefore \quad x - 4y = -12 + 3$$

$$\therefore \quad x - 4y = -9 \quad \text{—— (II)}$$

Substract eq? (II) from eq? (I),

$$\begin{array}{rl} & x + y = 31 \\ - & x - 4y = -9 \\ \hline & 5y = 40 \end{array}$$

$$\therefore \quad y = \frac{40}{5}$$

$$\therefore \quad \boxed{y = 8}$$

Put $y = 8$ in eq? (I),

$$x + y = 31$$

$$\therefore \quad x + 8 = 31$$

$$\therefore \quad x = 31 - 8$$

$$\therefore \quad \boxed{x = 23}$$

$\therefore$ The present age of Manish = 23 years and the present age of Savita = 8 years.

(5) In a factory the ratio of salary of skilled and unskilled workers is 5 : 3. Total salary of one day of both of them is ₹ 720. Find daily wages of skilled and unskilled workers.

Soln:- Let, the daily wages of skilled & unskilled workers be '$x$' rupees and '$y$' rupees respectively.

Now, The ratio of skilled & unskilled workers is 5 : 3.

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

$$\therefore \quad 3x = 5y$$

$\therefore \quad 3x - 5y = 0 \quad \text{— (I)}$

Also, the sum of daily wages of skilled & unskilled workers is ₹ 720.

$\therefore \quad x + y = 720$

Multiply both sides by 5,

$\therefore \quad 5 \times x + 5 \times y = 5 \times 720$

$\therefore \quad 5x + 5y = 3600 \quad \text{— (II)}$

Add eqn. (I) & eqn (II),

$$\begin{array}{rl} & 3x - 5y = 0 \\ + & 5x + 5y = 3600 \\ \hline & 8x \quad\quad = 3600 \end{array}$$

$\therefore \quad x = \frac{3600}{8}$

$\therefore \quad \boxed{x = 450}$

Put $x = 450$ in eqn (I),

$3x - 5y = 0$

$(3 \times 450) - 5y = 0$

$\therefore \quad 5y = 1350$

$\therefore \quad y = \frac{1350}{5}$

$\therefore \quad \boxed{y = 270}$

$\therefore$ The daily wages of skilled worker is ₹ 450 & the daily wages of unskilled workers is ₹ 270.

★
(6) Places A and B are 30 km apart and they are on a straight road. Hamid travels from A to B on bike. At the same time Joseph starts from B on bike, travels towards A. They meet each other after 20 minutes. If Joseph would have started from B at the same time but in the opposite direction (instead of towards A) Hamid would have caught him after 3 hours. Find the speed of Hamid and Joseph.

Soln:- Let, the speed of Hamid and Joseph be '$x$' km/Hr & '$y$' km/Hr respectively.

Now, Hamid and Joseph start from place A & B and travel towards each other. They meet each other after 20 minutes.

Time = 20 minutes = $\frac{20}{60} = \frac{1}{3}$ Hours.

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

$\therefore$ Distance travelled by Hamid,

$= \text{Speed} \times \text{Time}$

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

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

& The distance travelled by Joseph,

$= \text{Speed} \times \text{Time}$

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

$= \frac{y}{3}$ km.

$\therefore \quad \frac{x}{3} + \frac{y}{3} = 30$

$\therefore \quad 3 \times \frac{x}{3} + 3 \times \frac{y}{3} = 3 \times 30$

$\therefore \quad x + y = 90 \quad - (I)$

Now, Hamid and Joseph start from place A & B and travel away from each other. They meet each other after 3 hours.

$\therefore$ Distance travelled by Hamid,

$= \text{Speed} \times \text{Time}$

$= x \times 3$

$= 3x \text{ km}$

& The distance travelled by Joseph.

$= \text{Speed} \times \text{Time}$

$= y \times 3$

$= 3y \text{ km}.$

$\therefore \quad 3x - 3y = 30$

$\therefore \quad \frac{3x}{3} - \frac{3y}{3} = \frac{30}{3}$

$\therefore \quad x - y = 10 \quad \text{— (II)}$

Add eq$^n$ (I) & eq$^n$ (II).

$\therefore \quad x + y = 90$

$+ \quad x - y = 10$

$2x = 100$

$\therefore \quad x = \frac{100}{2}$

$\therefore$ $\boxed{x = 50}$

Put $x = 50$ in eq? (I),

$\therefore$ $x + y = 90$

$\therefore$ $50 + y = 90$

$\therefore$ $y = 90 - 50$

$\therefore$ $\boxed{y = 40}$

$\therefore$ The speed of Hamid is 50 km/Hr and the speed of Joseph is 40 km/Hr.