

RUNNING NOTES

Arithmetic

Teacher's handwritten notes, typed

IN THESE NOTES

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Time & work

① If A can finish a piece of work in n days, then A's 1 days work = $\frac{1}{n}$

Ex: If A can finish a piece of work in 18 days, then A's 1 days work = $\frac{1}{18}$

② If A is twice as good a workman as B, then Time taken by A to finish the work = $\frac{1}{2} \times$ (Time taken by B)

③ [table: No. of men's | Time take to finish the work (in hrs)]

10 | 20

20 | ? x

[arcs joining 10 with 20 and 20 with x]

$$10 \times 20 = 20 \times x \text{ [20s cancelled]}$$

$$x = 10$$

Here No. of mens $\propto \frac{1}{\text{Time taken to finish the work.}}$

Ex If the number of men to do a work be changed in the ratio 2 : 3, the time taken by them to finish the work in the ratio [3 : 2]

$$M_1 \propto \frac{1}{T_1}$$

$$M_1 = \frac{k}{T_1}$$

$$M_2 = \frac{k}{T_2}$$

$$\frac{M_1}{M_2} = \frac{T_2}{T_1}$$

$$\Rightarrow \frac{T_1}{T_2} = \frac{M_2}{M_1}$$

Ex: A can do a piece of work in 12 days and B alone can do it in 15 days. How much time both will take to finish the work.?

Sol A's 1 days work = $\frac{1}{12}$

B's 1 days work = $\frac{1}{15}$

$$\therefore (A + B)\text{'s 1 days work} = \frac{1}{12} + \frac{1}{15} = \frac{5 + 4}{60} = \frac{9}{60} = \frac{3}{20}$$

$$\therefore \text{Both together can finish the work in } \frac{20}{3} \text{ days} = 6 \frac{2}{3} \text{ days}$$

Ex: A and B together can do a piece of work in 12 days, B alone can finish it in 30 days. In how many days can A alone finish the work?

Sol $(A + B)$'s 1 day's work = $\frac{1}{12}$

B's 1 day's work = $\frac{1}{30}$

$$\Rightarrow \text{A's 1 day's work} = \frac{1}{12} - \frac{1}{30} = \frac{5-2}{60} = \frac{3}{60} = \frac{1}{20}$$

$\therefore$ A alone can finish the work = 20 days.

Ans (20)

→ A and B can do a piece of work in 12 days; B and C in 15 days; C And A in 20 days. In how many days will they finish it together and separately?

Sol $(A + B)$'s 1 day's work = $\frac{1}{12}$

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

$(C + A)$'s 1 days work = $\frac{1}{20}$

Adding

$$2(A + B + C)\text{'s 1 day's work} = \frac{1}{12} + \frac{1}{15} + \frac{1}{20} = \frac{5+4+3}{60} = \frac{12}{60} = \frac{1}{5}$$

$$\Rightarrow (A + B + C)\text{'s days work} = \frac{1}{10}$$

$\therefore$ A, B, C together can finish the work in 10 days

A's 1 days work = $(A + B + C)$'s 1 day's work – $(B + C)$'s 1 day's work

$$= \frac{1}{10} - \frac{1}{15}$$

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

$\therefore$ A alone can finish the work in 30 day.

Similarly we find, B alone can finish the work = ____

C " " " " = ____

→ A can do a piece of work in 25 days and B can finish it in 20 days. They work together for 5 days and then A goes away. In how many days will B finish the work?

Sol A's 1 days work = $\frac{1}{25}$

B's 1 days work = $\frac{1}{20}$

$$(A + B)\text{'s 1 days work} = \frac{1}{25} + \frac{1}{20} = \frac{9}{100}$$

$$(A + B)\text{'s 5 days work} = 5 \times \frac{9}{100} = \frac{9}{20}$$

$$\text{Remaining work} = 1 - \frac{9}{20} = \left(\frac{11}{20}\right)$$

$$\text{This work is done by B in } 11 \times \frac{1}{20}$$

$$= 11 \text{ days}$$

→ A can do a piece of work in 12 days while B alone can do it in 15 days. With the help of C they can finish it 5 days. If they are paid Rs 960 for the whole work, how should the money be divided among them?

Sol: A's 1 day's work = $\frac{1}{12}$ ✓

B's 1 day's work = $\frac{1}{15}$ ✓

$$(A + B)\text{'s 1 day's work} = \frac{1}{12} + \frac{1}{15} = \frac{9}{60} = \frac{3}{20}$$

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

$$C\text{'s 1 day's work} = \frac{1}{5} - \frac{3}{20} = \frac{1}{20} \text{ ✓}$$

$$\text{Consider } \frac{1}{12} : \frac{1}{15} : \frac{1}{20} = \frac{5}{60} : \frac{4}{60} : \frac{3}{60} = 5 : 4 : 3$$

∴ money (960/-) must be divided among them in the ratio = 5 : 4 : 3

$$A\text{'s share} = 960 \times \frac{5}{12} = 400/-$$

$$B\text{'s share} = 960 \times \frac{4}{12} = 320/-$$

$$C\text{'s share} = 960 \times \frac{3}{12} = 240/-$$

[960 and 12 cancelled, 80 written above]

$$5 + 4 + 3 = 12$$

→ A can do a piece of work in 10 days; B in 15 days. They work together for 5 days. The rest of the work is finished by C in 2 days. If they get Rs 1920 for the whole work, how should they divide the money and what are their daily wages?

Sol: A's 1 day's work = $\frac{1}{10}$

$$B\text{'s 1 day's work} = \frac{1}{15}$$

$$(A + B)\text{'s 1 day's work} = \frac{1}{10} + \frac{1}{15} = \frac{5}{30} = \frac{1}{6}$$

$$(A + B)\text{'s 5 days work} = \frac{5}{6}$$

$$\text{Remaining work} = 1 - \frac{5}{6} = \frac{1}{6}$$

$$\therefore C\text{'s 2 day's work} = \frac{1}{6}$$

$$\text{C's 1 days work} = \frac{1}{12}$$

$$\text{A's 5 day's work} = \frac{5}{10} = \frac{1}{2}$$

$$\text{B's 5 days work} = \frac{5}{15} = \frac{1}{3}$$

$$\text{C's 2 day's work} = \frac{2}{12} = \frac{1}{6}$$

$$\text{Consider } \frac{1}{2} : \frac{1}{3} : \frac{1}{6} = 3 : 2 : 1$$

$$\text{A's share} = 3 \times \frac{1920}{6} = 960/-$$

$$\text{B's share} = 2 \times \frac{1920}{6} = 640/-$$

$$\text{C's share} = 1 \times \frac{1920}{6} = 320/-$$

$$\text{For 5 days A's amount} = 960$$

$$\text{A's daily wage} = \frac{960}{5} = 192/-$$

$$\text{For 5 day's B's amount} = 640$$

$$\text{B's daily wage} = \frac{640}{5}$$

$$= 128/-$$

$$\text{For 2 day's C's amount} = 320$$

$$\text{C's daily wage} = \frac{320}{2}$$

$$= 160$$

H.W → A is thrice as good a workman as B and is therefore able to finish a piece of work in 60 days less than B. Find the time in which they can do it work together.

Sol Suppose B finish the work in x days

⇒ A is able to finish it in (x – 60) days

$$\text{Time taken by A} = \frac{1}{3} (\text{Time taken by B})$$

$$\therefore x - 60 = \left(\frac{1}{3}\right)x.$$

$$\Rightarrow 3x - 180 = x$$

$$\Rightarrow 2x = 180$$

$$\Rightarrow x = 90$$

$$\therefore \text{Time taken by B} = 90 \text{ days}$$

$$\text{Time taken by A} = 30 \text{ days.}$$

$$\text{A's 1 days work} = \frac{1}{30}$$

$$\text{B's 1 days work} = \frac{1}{90}$$

$$(A + B)\text{'s 1 days work} = \frac{1}{30} + \frac{1}{90} = \frac{3+1}{90} = \frac{4}{90} = \frac{2}{45}$$

A and B together can finish the work in $\frac{45}{2}$ days

i.e $22\frac{1}{2}$ days

→ A can do a piece of work in 10 days, B in 12 days and C is 15 days. All begin together, but A leaves the work after 2 days and B leaves 3 days before the work is finished. How long did the work last?

[diagram: time line with A leaving after 2 days and B leaving 3 days before the end]

Sol A's 1 days work = $\frac{1}{10}$

B's " " = $\frac{1}{12}$

C's " " = $\frac{1}{15}$

A, B, C together work for 2 days.

C alone works for 3 days

The remaining work is done by B & C together

$$\begin{aligned}(A + B + C)\text{'s 2 days work} &= 2\left(\frac{1}{10} + \frac{1}{12} + \frac{1}{15}\right) \\ &= 2\left(\frac{6+5+4}{60}\right) \\ &= 2\left(\frac{15}{60}\right) \\ &= \frac{1}{2}\end{aligned}$$

C's 3 days work = $3 \times \frac{1}{15} = \frac{1}{5}$.

$$\begin{aligned}\text{Remaining work} &= 1 - \left(\frac{1}{2} + \frac{1}{5}\right) \\ &= 1 - \frac{7}{10} \\ &= \frac{3}{10}\end{aligned}$$

(B + C)'s 1 day's work = $\frac{1}{12} + \frac{1}{15} = \frac{9}{60} = \frac{3}{20}$

∴ $\frac{3}{20}$ work is done (B + C) in 1 days

$$\begin{aligned}\frac{3}{10} \text{ work is done (B + C) in } &\frac{3}{10} \times \frac{1}{\frac{3}{20}} \\ &= \frac{20}{10} \\ &= 2 \text{ days.}\end{aligned}$$

(A + B + C's) → 2 days

(B + C's) → 2 days

C's → 3 days

Total 7 days

∴ Total time taken = 7 days.

→ A and B can do a piece of work in 45 and 40 days respec. They began the work together but A leaves after some days and B finished the remaining work in 23 days After how many days did A leave!

Sol A's 1 days work = $\frac{1}{45}$

B's 1 days work = $\frac{1}{40}$

(A + B)'s 1 days work = $\frac{1}{45} + \frac{1}{40} = \frac{17}{360}$

B's 23 days work = $23 \times \frac{1}{40} = \frac{23}{40}$

Remaining work = $1 - \frac{23}{40} = \frac{17}{40}$

(A + B)'s x days work = $\frac{17}{40}$

∴ $\frac{17}{40} = \left(\frac{17}{360}\right) \times x$.

x = 9 day

∴ (A + B)'s together done in 9 days

∴ A left after 9 days

→ A can do a piece of work in 120 days and B can do it in 150 days. They work together for 20 days. Then, B leaves and A alone continues the work. 12 day's after that C joins A and the work is completed in 48 days more. In how many day's can 'C' do it, if he work's alone?

[diagram: time line divided into A & B 20 days, A 12 days, A & C 48 days]

Sol A's 1 day's work = $\frac{1}{120}$

B's 1 day's work = $\frac{1}{150}$

(A + B)'s 1 days work = $\frac{1}{120} + \frac{1}{150} = \frac{5+4}{600} = \frac{9}{600} = \frac{3}{200}$

(A + B)'s 20 day's work = $20 \times \frac{3}{200} = \frac{3}{10}$

$$A's\ 12\ day's\ work = \frac{12}{120} = \frac{1}{10}$$

$$(A + C)'s\ 48\ day's\ work = 1 - \left(\frac{3}{10} + \frac{1}{10}\right)$$

$$= 1 - \frac{4}{10}$$

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

$$= \frac{3}{5}$$

$$\Rightarrow (A + C)'s\ 1\ day's\ work = \frac{3}{5 \times 48} = \frac{1}{80}$$

$$C's\ 1\ day's\ work = \frac{1}{80} - \frac{1}{120} = \frac{3-2}{240} = \frac{1}{240}$$

C can finish the work in 240 days

→ A and B can do a piece of work in 12 days. B and C together can do it in 15 days. If A is twice as good a work man as C, find in what time B alone can do it.

Sol $(A + B)'s\ 1\ day's\ work = \frac{1}{12}$

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

A's 1 day's work = C's 2 day's work.

$$C's\ 2\ day's\ work + B's\ 1\ day's\ work = \frac{1}{12}$$

$$\Rightarrow C's\ 1\ day's\ work + (B + C)'s\ 1\ day's\ work = \frac{1}{12}$$

$$\Rightarrow C's\ 1\ day's\ work + \frac{1}{15} = \frac{1}{12}$$

$$C's\ 1\ day's\ work = \frac{1}{12} - \frac{1}{15} = \frac{5-4}{60} = \frac{1}{60}$$

B's 1 day's work = (B + C)'s 1 day's work – C's 1 day's work

$$= \frac{1}{15} - \frac{1}{60}$$

$$= \frac{4-1}{60}$$

$$= \frac{3}{60}$$

$$= \frac{1}{20}$$

∴ B alone can finish the work in 20 day's

→ A and B working alone can finish a piece of work in 8 and 7 days respe. If they work at it alternately for a day, A beginning, in how many days will the work be finished?

Sol A's 1 day's work = $\frac{1}{8}$

B's 1 day's work = $\frac{1}{7}$

A's 1 day work + B's 1 day's work = work done in 1st 2 day's = $\frac{1}{8} + \frac{1}{7} = \frac{7+8}{56} = \frac{15}{56}$

work done in 1st 6 day's = $3 \times \frac{15}{56} = \frac{45}{56}$

on 7th day, it is A's turn

$$\begin{aligned}\therefore \text{work done in first 7 days} &= \frac{45}{56} + \frac{1}{8} \\ &= \frac{45+7}{56} \\ &= \frac{52}{56} \\ &= \frac{13}{14}\end{aligned}$$

Remain work = $1 - \frac{13}{14}$

$$= \frac{1}{14}$$

B's 1 days work = $\frac{1}{7}$

B's $\frac{1}{2}$ days work = $\frac{1}{14}$

$\therefore$ Remaining work can done by B in $\frac{1}{2}$ days

$\therefore$ Total no. of days = $7\frac{1}{2}$ days

→ A certain number of men complete a piece of work in 60 days. If there were 8 men more, the work could be finished in 10 days less. How many were originally there?

Sol: Let the original number of men be x

[table: No. of mens | No. of days to finish the work]

$x \mid 60$

$x + 8 \mid 60 - 10 = 50$

[arcs joining x with 60 and x + 8 with 50]

No of mens $\propto \frac{1}{\text{No.of days}}$

$x \times 60 = (x + 8) \times 50$

$6x = 5x + 40 \rightarrow (x = 40)$

→ If 4 men (or) 6 Boys can finish a piece of work in 20 days, in how many days can 6 men and 11 boys finish it?

Sol 4 men = 6 Boys.

$$6 \text{ men} = ? \left(\frac{6}{4}\right) \times 6 = 9 \text{ Boys [cancelled to } \frac{3}{2} \times 6]$$

[table: No. of Boys | No. of days]

$$6 \mid 20$$

$$6 \text{ men} + 11 \text{ boys} = 9 \text{ Boys} + 11 \text{ boys} = 20 \text{ Boys} \mid x.$$

$$\text{No. of Boys} \propto \frac{1}{\text{No. of days}}$$

$$6 \times 20 = 20 \times x$$

$$x = 6$$

→ 2 men and 3 women working 7 hours a day finish a work in 5 days; 4 men and 4 women working 3 hours a day do the same work in 7 days. Find the no. of days in which the work is done by 7 men only, working 4 hours a day

Sol case(i) 1 day | 7 hours

$$1 \text{ day} \mid 1 \text{ hour}$$

case(ii) 1 day 1 hour

no. of men

$$2 \times 5$$

$$2 \times 5 \times 7 = 70$$

$$4 \times 7 \times 3 = 84$$

No. of wommens

$$3 \times 5.$$

$$3 \times 5 \times 7 = 105$$

$$4 \times 7 \times 3 = 84$$

$$\text{from (i), (ii)} \quad 70m + 105w = 84m + 84w$$

$$\Rightarrow 21w = 14m$$

$$\Rightarrow 3w = 2m$$

$$[2m + 3w]$$

↓

$$[2m + 2m]$$

[table: men | No. of hours | No. of days]

$$4m \mid 7 \mid 5.$$

$$7m \mid 4 \mid x.$$

total

4m — 35 hours

7m — 4x hours

$$4 \times 35 = 7 \times 4x \text{ [4 and 7 cancelled]}$$

$$(x = 5)$$

→ If 2 men with 3 boys can earn Rs 252 in 7 days and 4 men with 7 boys can earn Rs 624 in 8 days; in what time 6 men with 8 boys earn Rs 1020?

Sol 1 men for 1 day he earn x/-

1 boy for 1 day he earn y/-

$$(2x + 3y)7 = 252$$

$$2x + 3y = 36 \text{ — ①}$$

$$(4x + 7y)8 = 624$$

$$4x + 7y = 78 \text{ — ②}$$

$$\text{①} \times 2 \Rightarrow 4x + 6y = 72$$

$$\text{②} \rightarrow 4x + 7y = 78$$

$$-y = -6$$

$$y = 6$$

$$x = 9$$

$$(6x + 8y)n = 1020$$

$$\Rightarrow (54 + 48)n = 1020$$

$$\Rightarrow (102)n = 1020$$

$$\Rightarrow n = 10 \text{ days}$$

→ 25 men are employed to do a piece of work which they could finish in 20 days, but the men drop off by 5 at the end of every 10 days. In what time will the work be completed?

$$\text{Ans } 10 + 10 + 3 \frac{1}{3} = 23 \frac{1}{3} \text{ days}$$

$$\text{Sol. work done by 25 men in 10 days} = 10 \times \frac{1}{20} = \frac{1}{2}$$

$$\text{Remaining work} = \frac{1}{2}, \text{ remaining men} = 20$$

$$[25 \rightarrow \frac{1}{2}; 1 \rightarrow \frac{1}{50}]$$

$$\text{work done by 20 men in 10 days} = 20 \times \frac{1}{50} = \frac{2}{5}$$

$$\text{Remaining work} = \frac{1}{2} - \frac{2}{5} = \frac{1}{10}, \text{ remaining men} = 15.$$

$$\text{work done by 15 men in 10 days} = \frac{15}{50} = \frac{3}{10}$$

$$\frac{1}{10} \text{ work can be done 15 men} = \frac{10}{3} \text{ days} = 3 \frac{1}{3} \text{ day.}$$

→ A can do half much again as B can do in the same time. B alone can do a piece of work in 18 days. Find, in how many days both together can finish the work.

Sol $(\frac{x}{2} + x) \rightarrow$ A's work

$(x) \rightarrow$ B's work

Ratio of working of A & B = $\frac{3x}{2} : x = \frac{3}{2} : 1 = 3 : 2$

Ratio of time taken for same work = $2 : 3$

Time taken by B alone to finish = 18 days

Time taken by A alone to finish = $2k = 12$ days

$3k = 18$

$k = 6$

A's 1 day's work = $\frac{1}{12}$, B's 1 day's work = $\frac{1}{18}$

(A + B)'s 1 day work = $\frac{1}{12} + \frac{1}{18} = \frac{3+2}{36} = \frac{5}{36}$

Time taken (A + B) to finish the work = $\frac{36}{5} = 7\frac{1}{5}$ days.

Boats and streams

① If the speed of a boat in still water = $[x]$ km/hr.

speed of the stream = $[y]$ km/hr then

(i) Speed of boat along the stream (i.e down stream) = $(x + y)$ km/hour

(ii) Speed of boat against stream (i.e. upstream) = $(x - y)$ km/h

[diagram: river between two banks with arrows showing a boat going down and up the stream]

② If a man rows in still water at x km/hour and the rate of current (or, stream) is y km/h then

(i) man's rate with current = $(x + y)$ km/h

(ii) man's rate against the current = $(x - y)$ km/h

③ (i) Rate in still water = $\frac{1}{2} [(rate\ with\ current) + (rate\ against\ the\ current)]$

(ii) Rate of current = $\frac{1}{2} [(rate\ with\ current) - (rate\ against\ the\ current)]$

Ex A man can row downstream at the rate of 14 km/hr. and upstream at 5 km/hr Find man's rate in still water and the rate of current.

Sol

[arrows: rate of current $\rightarrow y$ km/hr; man's rate in still water $\rightarrow x$ km/hr]

Given $x + y = 14$ km/h

$x - y = 5$ km/h

Adding

$$2x = 19$$

$$x = \frac{19}{2} = 9.5 \text{ km/h}$$

Subtracting

$$2y = 9$$

$$y = \frac{9}{2} = 4.5 \text{ km/h.}$$

Ex A man rows upstream 16 km and downstream 27 km taking 5 hours each time What is the velocity of current.

Sol $x + y = \frac{27}{5} \text{ km/h}$

$$(-) x - y = \frac{16}{5} \text{ km/h}$$

$$2y = \frac{27}{5} - \frac{16}{5}$$

$$2y = \frac{11}{5}$$

$$y = \frac{11}{10} = 1.1 \text{ km/h.}$$

[arrow: velocity of current]

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Time}}$$

$$5 \text{ hour} = 27 \text{ km}$$

$$1 \text{ hour} = \frac{27}{5}$$

Ex: A man can row 4.5 km/hr in still water and he finds that it takes him twice as long to row up as to row down the river. Find the rate of stream.

Sol: $x = 4.5 \text{ km/hr}$

Given $2(x - y) = x + y$. ✓

$$y = ?$$

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

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

$$\Rightarrow x = 3y$$

$$y = \frac{x}{3} = \frac{4.5}{3} = 1.5 \text{ km/hr}$$

Ex ! A man can row 5 km/hr in still water. If the river is running at 1.5 km/hr; it takes him 1 hour to row to a place and back. How far is the place?

Sol: Required distance = d km.

$$\text{speed along stream (downstream)} = 5 + 1.5 = 6.5 \text{ km/hr}$$

$$\text{speed against stream (upstream)} = 5 - 1.5 = 3.5 \text{ km/hr}$$

$$\text{Given Total Time to row d km and back} = 1$$

[diagram: river with arrows down and up, distance d marked]

$$S = \frac{D}{T}$$

$$T = \frac{D}{S}$$

$$\Rightarrow \frac{d}{6.5} + \frac{d}{3.5} = 1$$

$$\Rightarrow \frac{d}{\frac{13}{2}} + \frac{d}{\frac{7}{2}} = 1$$

$$\Rightarrow \frac{2d}{13} + \frac{2d}{7} = 1$$

$$\Rightarrow 2d\left(\frac{1}{13} + \frac{1}{7}\right) = 1$$

$$\Rightarrow 2d\left(\frac{7+13}{91}\right) = 1$$

$$\Rightarrow 2d\left(\frac{20}{91}\right) = 1$$

$$\Rightarrow d = \frac{91}{40}$$

$$\Rightarrow d = 2.275 \text{ km}$$

$$6.5 = \frac{65}{10} = \frac{13}{2}$$

$$\frac{35}{10} = \frac{7}{2}$$

[long division: 40) 91 (2.275; 80; 110; 80; 300; 280; 200; 200]

→ The current of a stream runs at the rate of 2 km/hr. A motor boat goes 10 km upstream and back again to the starting point in 55 minutes. Find the speed of the motor boat in still water.

Sol The speed of the boat in still water = x km/h

rate of current = y = 2 km/hr

speed of upstream = (x - 2) km/hr

speed of down stream = (x + 2) km/hr

Given Total time = 55 min = $\frac{55}{60}$ hr = $\frac{11}{12}$ hr

[small sketch: arrows up and down]

$$\Rightarrow \frac{10}{x-2} + \frac{10}{x+2} = \frac{11}{12}$$

$$\Rightarrow 10\left(\frac{1}{x-2} + \frac{1}{x+2}\right) = \frac{11}{12}$$

$$\Rightarrow 10\left(\frac{x+2+x-2}{(x-2)(x+2)}\right) = \frac{11}{12}$$

$$\Rightarrow \frac{10(2x)}{x^2-4} = \frac{11}{12}$$

$$\Rightarrow 240x = 11x^2 - 44$$

$$\Rightarrow 11x^2 - 240x - 44 = 0$$

$$\Rightarrow 11x^2 - 242x + 2x - 44 = 0$$

$$T = \frac{D}{S}$$

$$S = \frac{D}{T}$$

$$\Rightarrow 11x(x - 22) + 2(x - 22) = 0$$

$$\Rightarrow (x - 22)(11x + 2) = 0$$

$$\Rightarrow x = 22 \text{ (or) } (x = -\frac{2}{11}) \text{ X}$$

Ans 22 km/hr.

$$(11 \times -44)$$

$$11 \times 4 \times 11$$

$$11 \times 2 \times 2 \times 11$$

$$121 \times 2 \times 2$$

$$242 \times 2$$

→ A man can row 30 km upstream and 44 km downstream in 10 hrs, while he can row 40 km upstream and 55 km downstream in 13 hrs. Find the rate of the current and the speed of the man in still water.

[arrows: speed of the man in still water → x km/h; rate of the current → y km/h]

Sol speed of upstream = (x - y) km/hr

Speed of downstream = (x + y) km/h.

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

$$30p + 44q = 10 \text{ — ①}$$

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

$$40p + 55q = 13 \text{ — ②}$$

$$\text{where } p = \frac{1}{x - y}, q = \frac{1}{x + y}$$

$$S = \frac{D}{T}$$

$$T = \frac{D}{S}$$

$$55 \times 3 = 165$$

$$44 \times 3 \text{ [?]}$$

$$\text{①} \times 4 \Rightarrow 120p + 176q = 40$$

$$\text{②} \times 3 \Rightarrow 120p + 165q = 39$$

- - -

$$11q = 1$$

$$q = \frac{1}{11}, 30p + 44q = 10$$

$$30p + \frac{44}{11} = 10 \left[\frac{44}{11} \text{ cancelled to } 4 \right]$$

$$30p = 6$$

$$p = \frac{6}{30} = \frac{1}{5}$$

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

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

$$x - y = 5$$

$$q = \frac{1}{11}$$

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

$$x + y = 11$$

$$2x = 16$$

$$x = 8, y = 3$$