

$$\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$$

Ex A can do a work in 12 days. When he had worked for 3 days B joined him. If they complete the work in 3 more days, in how many days can B alone finish the work?

$$A \rightarrow \frac{1}{12}$$

$$3 \text{ days} \rightarrow \underline{\underline{\frac{3}{12}}}.$$

$$\text{Remaining } \frac{1}{12} - \frac{3}{12} = \underline{\underline{\frac{1}{4}}}.$$

$$\text{Then, } \frac{1}{a} + \frac{1}{b} = \frac{1}{4} \Rightarrow \frac{1}{b} = \frac{1}{4} - \frac{1}{12} = \frac{3}{12} - \frac{1}{12} = \underline{\underline{\frac{1}{6}}}.$$

$$\text{Ans} \rightarrow \underline{\underline{6 \text{ days}}}.$$

Ex To do a certain work C alone takes twice as long as A & B together, A would take 3 times as long as B & C together. All 3 together complete the work in 5 days. How long would each take separately?

$$\begin{array}{ccc} A & B & C \\ a & b & c \end{array}$$

(Method)

$$\text{A \& B together} = \frac{1}{\frac{1}{a} + \frac{1}{b}} = \frac{ab}{a+b}$$

$$c = \frac{2ab}{a+b}$$

$$\text{Then, } a = 3 \times \frac{1}{\frac{1}{b} + \frac{a+b}{2ab}} = 3 \times \frac{1}{\frac{3ab}{2ab}} = \frac{6ab}{3ab} = \underline{\underline{2b}}$$

$$\Rightarrow 3ab = 6b$$

$$\Rightarrow \underline{\underline{3a = 5b}}$$

$$\begin{array}{ccc} A & B & C \\ a & b & c \end{array}$$

$$\frac{2ab}{a+b} = \frac{2a \times \frac{3a}{5}}{a+\frac{3a}{5}} = \frac{6a^2}{8a} = \frac{3a}{4}$$

$$= \underline{\underline{\frac{3a}{4}}}.$$

$$\text{Then, } \frac{1}{a} + \frac{5}{3a} + \frac{4}{3a} = \frac{1}{5}$$

$$\Rightarrow \frac{12}{3a} = \frac{1}{5}$$

$$\Rightarrow a = \underline{\underline{20}}. \quad b = \underline{\underline{12}} \quad c = \underline{\underline{15}}.$$

Ex 4 men or 5 women can construct a wall in 82 days. How long will it take 5 men & 4 women to do the same?

$$\text{Efficiency} \quad 4m = \underline{\underline{5w}} = \underline{\underline{82}}.$$

$$\begin{aligned} \text{Ans} &\rightarrow \frac{82}{4m} \\ &= \frac{82}{5m+4w} \\ &= \frac{82}{\frac{5 \times 82}{9} + \frac{4 \times 82}{5}} \\ &= \frac{1}{\frac{5}{9} + \frac{4}{5}} = \frac{1}{\frac{25+36}{45}} = \frac{45}{61} \end{aligned}$$

$$5m+4w$$

$$= 5m + 4 \times \frac{4m}{5} = \frac{41m}{5}.$$

$$4m \rightarrow 82$$

$$\begin{aligned} \frac{41m}{5} &= \frac{82}{4m} \times \frac{4m \times 5}{4m} \\ &= \underline{\underline{40 \text{ days}}} \end{aligned}$$

Ex X is 3 times as fast as Y and is able to complete the work in 40 days less than Y. Find the time in which they can complete the work together.

$$\text{Efficiency}$$

$$X \quad Y$$

$$3y \quad y$$

$$\frac{1}{3y} + \frac{1}{40} = \frac{1}{4}$$

$$\Rightarrow \frac{1}{4} - \frac{1}{3y} = \frac{1}{40}$$

$$\Rightarrow \frac{2}{3y} = \frac{1}{40} \Rightarrow y = \frac{1}{60}$$

$$\text{Ans} \rightarrow \frac{1}{60} + \frac{1}{20} = \frac{1}{15} \quad \underline{\underline{15 \text{ days}}}$$

Ex Sita can finish the same work in 12 days working 4 hrs/day. Gita can finish the same in 15 days working 3 hrs/day. In how many days they can finish it working together at $4\frac{1}{2}$ hrs per day?

Efficiency

$$3 \times 12 \times 4 = 9 \times 15 \times 3$$

$$\Rightarrow 16s = 15g$$

$$\text{Ans} \rightarrow \frac{48s}{(s+g) \frac{9}{2}} = \frac{96s}{9 \times (s+16s) \frac{15}{2}} = \frac{32s \times \frac{15}{2}}{3 \times (31s)} = \frac{160}{31} = 5 \frac{5}{31} \text{ days.}$$

Ex A and B each working alone can do a work in 10 & 15 days respectively. They started the work together, but B left after sometime and A finished the remaining work in 5 days. After how many days from the start did B leave?

$$\frac{1}{10} + \frac{1}{15} = \frac{3+2}{30} = \frac{1}{6}$$

$$\text{Ans} \rightarrow \frac{Y_2}{Y_6} = \frac{3}{2}$$

Ex A contractor decided to complete the work in 40 days and employed 60 men at the beginning and 40 men additionally after 10 days and got the work completed at per schedule. If he had not employed the additional men, how many extra days would he have needed to complete the work?

Efficiency

$$\frac{60m + 100m \times 30}{60} = \underline{\underline{3600m}}$$

Ans $\rightarrow \frac{3600m}{60} = \underline{\underline{60}} = \underline{\underline{20 \text{ days}}}$

Ex A group of 35 men is employed to complete some work in 45 days. After 33 days, 5 more men are employed and the work is finished 1 day earlier. If 5 more men were not employed, how many more days would it have taken beyond the expected period?

Efficiency

$$35m \times 33 + 40m \times 14 = \underline{\underline{1715m}}$$

Ans $\rightarrow \frac{1715m}{35m} = \underline{\underline{49}} = \underline{\underline{1 \text{ day more.}}}$

Ex A and B, working separately, can do a piece of work in 12 and 15 days. They work on alternate days starting with A on the 1st day. In how many days the work will be completed?

time

$$\frac{1}{12} + \frac{1}{15} = \frac{5+4}{60} = \underline{\underline{\frac{9}{60}}}.$$

$\frac{5}{60} \swarrow \quad \frac{4}{60} \searrow$

$$\frac{9}{60} \times 6 + \frac{5}{60} + \frac{1}{60}$$

↓

Ans $\rightarrow 6 \times 2 + 1 + \underline{\underline{1}} = \underline{\underline{13 \frac{1}{2} \text{ days.}}}$

Ex

A, B and C can earn together Rs 1620 in 9 days. A and C can earn Rs 500 in 5 days, whereas B & C earn Rs 910 in 7 days. Find the daily earnings of C?

Wage

$$A + B + C = 180$$

$$A + C = 120$$

$$B + C = 130$$

$$\Rightarrow A + B + 2C = 250$$

$$\Rightarrow C = \underline{\underline{70}}.$$

Ex 2 pipes A & B fill a tank in 20 & 30 min respectively. If both pipes are opened at once after how much time should A be closed so that the tank is filled in 15 mins?

$$\frac{1}{20} + \frac{1}{30} = \frac{3+2}{60} = \frac{1}{12}$$

$$\begin{array}{c|c|c} \frac{x}{12} & + & \frac{15-x}{30} = 1 \\ \hline \end{array}$$
$$\frac{x}{12} + \frac{(15-x)}{30} = 1$$
$$\Rightarrow \frac{x}{12} + \frac{1}{2} - \frac{x}{30} = 1$$
$$\Rightarrow \frac{5x-2x}{60} = \frac{1}{2}$$
$$\Rightarrow \frac{3x}{60} = \frac{1}{2} \Rightarrow x = \underline{\underline{10}}$$

Ex A tank has a leak, which would empty it in 8 hrs. A tap is turned on which fills at the rate of 4 Litres/min and the tank is now emptied in 12 hrs. Find the capacity of the tank.

$$-\frac{1}{a} + \frac{1}{8} = \frac{1}{12}$$

$$\Rightarrow \frac{1}{a} = \frac{1}{8} - \frac{1}{12} = \frac{1}{24}$$

$$\text{extractions } \frac{1}{24} \rightarrow 4 \text{ Litres/min}$$

$$\frac{1}{8} \rightarrow 12 \text{ Litres/min}$$

$$\text{Ans} \rightarrow 8 \times 60 \times 12 = \underline{\underline{5760}} \text{ Litres}$$

Ex P can do a certain work in 4 days and Q can do the same work in 12 days. They work for a few days after which P leaves and Q alone completes the remaining work. If it takes 6 days to complete the entire work, after how many days P leaves?

$$\frac{1}{4} + \frac{1}{12} = \frac{3+1}{12} = \frac{4}{12} \cdot \frac{1}{3} = \frac{1}{12}$$

$$x \times \frac{1}{12} + (6-x) \times \frac{1}{12} = 1$$

$$\rightarrow 4x + 6 - x = 12$$

$$\rightarrow x = \underline{\underline{6}}$$

Ans $\Rightarrow \underline{\underline{2}}$

Ex 15 men & 25 women can dig an area of 880m^2 in 8 days. In how many days can 20 men and 12 women dig an area of 1040m^2 if each man can dig twice the area each woman can dig in the same amount of time?

~~efficiency~~

$$m = \underline{\underline{200}}$$

$$(15m + 25w) \times 8 \Rightarrow 880$$

$$\frac{(15m + 25w) \times 8 \times 1040}{(20m + 12w) \times 880}$$

$$= \frac{55w \times 8 \times 1040}{52w \times 880}$$

$$= \frac{55 \times 8 \times 20}{880} = \underline{\underline{10 \text{ days}}}$$

Ex P, Q and R together can complete 50% of the work in 2 days. All the 3 start the work, but after 2 days Q leaves. P and R complete one-sixth of the work the next day and then P leaves. The remaining work is done by R alone in 8 days. In how many

days can P alone complete the work?

$$\frac{1}{P} + \frac{1}{Q} + \frac{1}{R} = \frac{1}{4}$$

$$2 \text{ days} \rightarrow \frac{1}{2} ; \text{ 3rd day} \rightarrow \frac{1}{6} ; \text{ Remaining} = 1 - \frac{1}{2} - \frac{1}{6} = \frac{6-3-1}{6} = \frac{1}{3}$$

$$\frac{1}{P} + \frac{1}{R} = \frac{1}{6}$$

$$\frac{8}{8} = \frac{1}{3} \Rightarrow \frac{1}{8} = \frac{1}{24}$$

$$\therefore \frac{1}{P} = \frac{1}{6} - \frac{1}{24} = \frac{3}{24}$$

$$\Rightarrow P = 8 \text{ days}$$

Ex A group of 5 persons can do a certain work in a certain no. of days. If 4 more persons join the group, they take 12 days less to do the same work. In how many days can a group of 3 persons do the work?

$$\frac{5}{x} \times 60 = \frac{9}{x} (n+2)$$

$$5n + 60 = 9n \Rightarrow n = 15.$$

$$\text{Ans} \rightarrow \frac{\frac{5}{x} \times 27}{\frac{3}{x}} = 45 \text{ days}$$

Ex P works 25% more efficiently than Q and Q works 50% more efficiently than R. To complete a certain project, P alone takes 50 days less than Q alone. If, in this project P alone works for 60 days and then Q alone works for 125 days. In how many days can R alone complete the remaining work?

~~Efficiency~~

$$P \quad Q \quad R \\ 15x \quad 12x \quad 8x$$

$$P \quad Q \quad R \\ \frac{15}{3000} \quad \frac{12}{3000} \quad \frac{8}{3000}$$

$$\frac{1}{15x} + 50 = \frac{1}{12x} \Rightarrow 50 = \frac{1}{12x} - \frac{1}{15x} = \frac{1}{60x} \Rightarrow x = \frac{1}{3000}$$

$$\frac{15}{3000} \times 60 + \frac{12}{3000} \times 125 = \frac{2400}{3000}$$

$$\text{Ans} \rightarrow \frac{600}{3000} \times \frac{3000}{8} = \underline{\underline{75}}$$

Ex P, Q and R take 7, 12 and 14 days respectively to complete a job, working individually. With the help of S, P, Q and R together complete the work in 2 days. Find S's share in a total of Rs 4200 paid to them.

$$\frac{1}{S} + \frac{1}{7} + \frac{1}{12} + \frac{1}{14} = \frac{1}{2}$$

$$\Rightarrow \frac{1}{S} = \frac{1}{2} - \frac{1}{7} - \frac{1}{12} - \frac{1}{14}$$

$$= \frac{42 - 12 - 7 - 6}{84}$$

$$= \frac{17}{84}$$

$$\frac{1}{P} : \frac{1}{Q} : \frac{1}{R} : \frac{1}{S} = \frac{1}{7} : \frac{1}{12} : \frac{1}{14} : \frac{17}{84}$$

$$\frac{12}{84} : \frac{7}{84} : \frac{6}{84} : \frac{17}{84}$$

$$\text{Ans} \rightarrow \frac{17}{42} \times 4200 = \underline{\underline{1700}}$$

Ex Anand, Raju, Surendra and Venkat together produced 392 pieces of an item in 6 hrs. Surendra is 4 times as efficient as Anand and is $\frac{1}{3}$ rd less efficient than Venkat. Raju is half as efficient as Venkat. How many pieces would Raju have produced if he worked for 8 hours?

Efficiency	A	R	S	V
	$2x$	$3x$	$12x$	$6x$

$$1428 \times 6 = 392$$

$$\Rightarrow x = \frac{392}{6 \times 23} = \frac{28}{6} = \frac{14}{3}$$

$$\text{Ans} \rightarrow \frac{392}{6 \times 23} \times 8 = \frac{14}{3} \times 8 = 112$$

Ex P, Q, R and S working together produce a total of 200 books. In producing books, P is thrice as efficient as Q but 75% less efficient than R. R is half as efficient as S. How many books did Q produce?

P	Q	R	S
39	9	27	81
129	249		

$$40 \text{ books} \rightarrow 200$$

$$9 \rightarrow 5$$

Ex R takes 5 times the time taken by P to do a certain work. P takes half the time taken by Q to do the same work. S takes 3 times the time taken by Q to do the same work. Q, R and S do $(\frac{5}{16})^{\text{th}}$, $(\frac{1}{4})^{\text{th}}$, $(\frac{3}{16})^{\text{th}}$ of the work respectively, P does the remaining work. If it takes 13 days to complete the work, one working after the other, what will be the no. of days taken by P, Q, R & S individually to complete the work?

Time	P	Q	R	S
	p	2p	5p	6p
Q	R	S	P	
$\frac{5}{16}$	$\frac{4}{16}$	$\frac{3}{16}$	$\frac{4}{16}$	

$$\frac{4}{16} \times p + \frac{5}{16} \times 2p + \frac{4}{16} \times 5p + \frac{3}{16} \times 6p = 13$$

$$\Rightarrow 52p = 13 \times 16 \Rightarrow p = 4.$$

$$\text{Ans} \rightarrow 4, 8, 20, 24$$

Ex P can complete a piece of work in 3 days. Q takes triple the time taken by P, R takes 4 times the time taken by Q, and S takes double the time taken by R to complete the same task. They are grouped into 2 pairs. One of the pairs takes 2 and a half times the time taken by the other pair to complete the work. Which is the 2nd pair?

Time	P	Q	R	S
=	3	9	36	72
	$\frac{P}{3}$ $\frac{R}{72}$	$\frac{Q}{9}$ $\frac{S}{72}$	$\frac{R}{36}$ $\frac{S}{72}$	

Efficiency	$\frac{1}{3}$	$\frac{1}{9}$	$\frac{1}{36}$	$\frac{1}{72}$
=	$\frac{24}{72}$	$\frac{8}{72}$	$\frac{2}{72}$	$\frac{1}{72}$
	$\frac{24}{72}$	$\frac{8}{72}$	$\frac{2}{72}$	$\frac{1}{72}$

Ans → P, S

Ex 3 friends Aravind, Manoj, Viswanath work together to complete a piece of work. The time it takes for them to do the work together is 2 hours less than what Aravind would have taken alone, 10 hours less than what Manoj would have taken alone and one-third the time Viswanath would have taken working alone. How long did it take for them to complete the work working together?

Time	A	M	V
<u>x</u>	$x+2$	$x+10$	$3x$

$$\frac{1}{x+2} + \frac{1}{x+10} + \frac{1}{3x} = \frac{1}{x}$$

$$\Rightarrow \frac{1}{x+2} + \frac{1}{x+10} = \frac{2}{3x}$$

$$\Rightarrow \frac{2x+12}{x^2+12x+20} = \frac{2}{3x}$$

$$\Rightarrow 3x^2 + 18x = x^2 + 12x + 20$$

$$\Rightarrow x^2 + 9x + 2 = 0$$

$$\Rightarrow 2x^2 + 6x - 20 = 0$$

$$\Rightarrow x^2 + 3x - 10 = 0$$

$$\Rightarrow (x+5)(x-2) = 0$$

Ans \Rightarrow 2 days

Ex In a tank, there is a leak, which can empty the tank in 20 hrs, at $\frac{3}{4}$ th of the height above the base. There are 2 pipes filling the tank which can fill the tank in 6 and 12 hrs respectively. How much time does it take to fill the tank, if both the filling pipes opened simultaneously?

$$\frac{1}{6} + \frac{1}{12} = \frac{3}{12}$$

$$\frac{1}{6} + \frac{1}{12} - \frac{1}{20} = \frac{10+5-3}{60} = \frac{12}{60}$$

$$\frac{\frac{3}{4}}{\frac{3}{12}} + \frac{Y_1}{\frac{12}{60}} = 3 + \frac{1}{4} \times \frac{15}{12} = 4 \frac{1}{4} \text{ hours}$$

Ex A, B and C are 3 taps connected to a tank such that 6 times the time taken by A to fill the tank is 7 times the time taken by B and C together to fill the tank. 3 times the time taken by C to fill the tank is 10 times the time taken by A and B together to fill the tank. If A, B and C together fill the tank in $4\frac{8}{13}$ hours, then find the time taken by B alone to fill the tank.

Time

A B C

$$\begin{matrix} & a & b & c \\ & \downarrow & & \downarrow \\ 6 & \frac{7bc}{b+c} & \end{matrix}$$

$$6a = \frac{7bc}{b+c}$$

$$\begin{matrix} & a & b & c \\ & \downarrow & & \downarrow \\ \frac{6}{7bc} & \frac{6}{b+c} + \frac{1}{b} & \end{matrix}$$

$$= \frac{6ab + 6bc + 7c}{7bc} = \frac{6b+13c}{7bc}$$

$$3x = 10 \times \frac{7b}{6b+13c}$$

$$\Rightarrow 18b + 39c = 70b$$

$$\Rightarrow 3c = 4b$$

$$\begin{array}{ccc}
 A & B & C \\
 \frac{7bc}{6(b+c)} & b & \frac{4b}{3} \\
 = \frac{7b \times \frac{4b}{3}}{6(b + \frac{4b}{3})} \\
 = \frac{28 \times b}{18 \times \frac{7}{3}} \\
 = \frac{2b}{3}
 \end{array}$$

Then, $\frac{3}{2b} + \frac{1}{b} + \frac{3}{4b} = \frac{13}{60}$

$$\Rightarrow \frac{6+4+3}{4b} = \frac{13}{60}$$

$$\Rightarrow b = \underline{\underline{15}}$$

Ans $\rightarrow \underline{\underline{15}} \text{ hrs.}$

Ex In a company, the engineers plan to do a certain work in 8 days with 8 machines. But, after 3 days, they find that only 30% of the work is done with the machine running for 5 hrs a day. If they want to complete the work in the planned time with the machines, how many hrs per day will the machines have to work?

Efficiency m

$$3 \times 8m \times 5 \times \frac{10}{3} = \underline{\underline{400m}}$$

$$\begin{array}{c}
 120m \\
 \diagdown \quad \diagup \\
 36m \qquad 84m \\
 \hline
 = \frac{280m}{5 \times 8m} = \underline{\underline{7 \text{ hrs}}}
 \end{array}$$

Ex L, M & N are 3 machines, which produce electronic gadgets, the efficiencies of prodⁿ of which are in the ratio 2:4:5. If L works for 7 days, M for 4 days and N for 2 days, they produce 1680 gadgets. How many gadgets are produced if L, M & N work for 3, 6, 4 days respectively?

$$\begin{array}{ccc} L & M & N \\ 2x & 4x & 5x \end{array}$$

$$14x + 16x + 10x = 1680$$

$$\Rightarrow 40x = 1680 \Rightarrow x = \underline{\underline{42}}$$

$$\text{Ans} \rightarrow 6x + 24x + 20x = 50x = 50 \times 42 = \underline{\underline{2100}}$$

Ex A house can be painted by 7 men and 2 women in 8 days, if they work for 12 hrs/day. Working at the same rate, 6 men and 20 women can do the same job in 4 days. In how many hrs can 8 men and 8 women paint the house?

$$\begin{aligned} (7m+2w) \times 8 \times 12 &= (6m+20w) 12 \times 4 \\ \Rightarrow 14m+16w &= 6m+20w \\ \Rightarrow 8m &= 16w \Rightarrow m = \underline{\underline{2w}} \end{aligned}$$

$$\begin{aligned} \frac{(7m+2w) \times 8 \times 12}{(8m+8w)} &= \frac{16w \times 96}{24w} = \underline{\underline{64 \text{ hrs}}} \end{aligned}$$

Ex P, Q and R can do a piece of work in 4, 6 and 12 days respectively, working for 12 hrs a day. On each day, P starts the work for 8 hrs and then R works for 8 hrs. In the same way they continue until P leaves after 2 days of work. Then Q and R work alternately for 8 hrs each till the work is completed. In how many days is the work completed?

$$18 \left(\frac{4}{12} + \frac{5}{20} + \frac{1}{15} \right) + 1$$

$$\begin{array}{ccc} P & Q & R \\ \frac{1}{48} & \frac{1}{72} & \frac{1}{144} \end{array}$$

$$\left(\frac{1}{48} \times 8 + \frac{1}{72} \times 8 + \frac{1}{144} \times 8 \right) \times 2 =$$

$$= 16 \times \frac{3+2+1}{144}$$

$$= \frac{6}{9} = \underline{\underline{\frac{2}{3}}}$$

$$8 \times \frac{1}{72} + 8 \times \frac{1}{144} = 8 \times \frac{3}{144} = \underline{\underline{\frac{1}{6}}}.$$

$$\therefore \frac{1}{3} : \frac{1}{6} = 2$$

$$\text{Ans} = 2 + 2 \times 8 / 16 = 3 + 8 \text{ hr} \\ = 3 \frac{1}{2} \text{ days.}$$

Ex P and Q can do a certain work together in 12 days, Q and R in 20 days, and P and R in 15 days. P, Q and R start working together. They work for 2 days after which Q leaves. After 10 more days Q rejoins and P leaves. Q works for 2 days along with R and then he leaves. The remaining work is completed by R. In how many days will be the work be completed?

$$\frac{1}{12} + \frac{1}{20} + \frac{1}{15} = \frac{5+3+4}{60} = \frac{1}{5} \rightarrow \frac{1}{5} \times \frac{1}{2} = \underline{\underline{\frac{1}{10}}}$$

$$\frac{1}{8} = \frac{1}{10} - \frac{1}{12} = \frac{1}{60}$$

$$\frac{1}{P} = \frac{1}{10} - \frac{1}{20} = \frac{1}{20}$$

$$\frac{1}{Q} = \frac{1}{10} - \frac{1}{15} = \frac{1}{30}$$

$$2 \text{ days} \rightarrow \frac{12}{60} + 10 \text{ days} \rightarrow \frac{40}{60} + 2 \text{ days} \rightarrow \frac{6}{60}$$

$$\frac{1}{20} + \frac{1}{60} = \frac{1}{15}$$

$$\frac{58}{60}$$

$$\frac{2}{60} \div \frac{1}{60} = 2.$$

$$\text{Ans} \rightarrow 2+10+2+2 = \underline{\underline{16 \text{ days}}}$$

Ex 3 men A, B and C working together can do a work in 30 days. They start the work together and A works for 3 days and takes rest on the 4th day. B works for 5 days and takes rest on the next 2 days and C works for 7 days and takes rest on the next 3 days. If A, B & C work at the same rate, in how many days will the work be completed? (a) 39 days (b) 40 days (c) 41 days (d) 42 days

$$\frac{1}{a} = \frac{1}{b} = \frac{1}{c} = \frac{1}{90}. \quad 90 \text{ man-days.}$$

A	B	C	
$39 \text{ days} \rightarrow 36 \times \frac{3}{4} + 3$	$35 \times \frac{5}{7} + 4$	$30 \times \frac{7}{10} + 7$	
$= \underline{\underline{30}}$	$= \underline{\underline{29}}$	$= \underline{\underline{28}}$	$= \underline{\underline{87}} \quad 3 \text{ more man-days}$

$$\text{Ans} \rightarrow \underline{\underline{41 \text{ days}}}$$

Ex A can do a piece of work in 20 days working 7 hrs a day. The work is started by A and on the 2nd day one man whose capacity to do the work is twice that of A joined. On the 3rd day another man whose capacity is thrice that of A joined. This manner of working continue till the work is completed. If every one works for 4 hrs a day, in how many days will the work be completed?

$$20 \times 7 = 140$$

$$4 + \underbrace{(4+8)}_{12} + \underbrace{(4+8+12)}_{24} + \underbrace{(4+8+12+16)}_{40} + \underbrace{(4+8+12+16+20)}_{60}$$

$$= \underline{\underline{5 \text{ days}}}$$

Ex The ratio of efficiencies of P, Q and R is 2:3:5. The total wages of P, Q, R working for 14, 27, 20 days respectively are Rs 6000. Find the total wage of the 3, when P works for 9 days, Q for 14 days and R for 8 days.

$$2x \quad 3x \quad 5x \\ 28x + 72x + 100x = 6000$$

$$\Rightarrow x = \underline{\underline{30}}$$

$$\text{Ans} \rightarrow 18x + 42x + 40x \\ = 100x = \underline{\underline{\text{Rs } 3000}}$$

Ex A can do a work in 6 days, which B can do in 9 days and C can do in 12 days. If a similar work is done in 24 days by all three of them working together, how many days will B alone take to complete the work?

$$\frac{1}{6} + \frac{1}{9} + \frac{1}{12} = \frac{6+4+3}{36} = \frac{13}{36} \quad \frac{36}{13} \text{ days.}$$

$$\cancel{\frac{24 \times 13}{13}} = \frac{24 \times 13}{36} = \frac{1}{\cancel{24}} = \underline{\underline{\frac{1}{3}}}$$

~~Q~~ XOPP

$$24 \div \frac{36}{13} = 24 \times \frac{13}{36} = \frac{26}{3} = \underline{\underline{\frac{2}{3}}}$$

$$\text{Ans} \rightarrow \frac{2}{3} \times 9 = \underline{\underline{18 \text{ days}}}$$

Ex B takes 18 days more than A to do a work. If A is thrice as efficient as B, and if they work together, in how many days do they complete the work?

efficiency

$$\begin{array}{c} A \\ 3b. \end{array} \quad \begin{array}{c} B \\ b \end{array}$$

$$\frac{1}{b} = \frac{1}{3b} + 18$$

$$\Rightarrow \frac{2}{3b} = 18$$

$$\Rightarrow b = \underline{\underline{\frac{2}{27}}}$$

Ans \rightarrow ~~A~~ $\frac{83}{27}$ ~~B~~ $\frac{1}{27}$

$$\underline{\underline{\frac{27}{4}}} = 6\frac{3}{4} \text{ days.}$$

Ex Pipes P and Q are inlet pipes while pipe R is an outlet pipe of a tank. Pipe P supplies water at 30 l/hr. Pipe Q can fill the tank in 6 hrs while R can empty it in 24 hrs. The empty tank gets filled in 2 hrs, when all 3 pipes are opened simultaneously. What is capacity of tank.

$$\frac{1}{P} + \frac{1}{Q} - \frac{1}{R} = \frac{1}{2}$$

$$\Rightarrow \frac{1}{P} = \frac{1}{2} - \frac{1}{6} + \frac{1}{24} = \frac{12-4+1}{24} = \frac{9}{24} = \underline{\underline{\frac{3}{8}}}.$$

$$\frac{3}{8} \rightarrow 30$$

$$\text{Ans} \rightarrow 30 \times \underline{\underline{\frac{8}{3}}} = 80 \text{ hrs.}$$

Ex A tank of dimension $18m \times 10m \times 8m$ is filled to its capacity. A drain pipe can empty the tank in 50 hrs. An inlet pipe supplies water at the rate of 6 L/sec. If both pipes are opened at the same time, how much time would they take to empty the tank?

$$1\text{ m}^3 = \underline{\underline{1000\text{ L}}}$$

$$\text{drain pipe} = \frac{18 \times 10 \times 8}{50} = \frac{144}{5} \text{ m}^3/\text{hr.} = 28.8 \text{ m}^3/\text{hr.}$$

$$\begin{aligned}\text{inlet pipe} &= 6 \text{ L/sec} = 6 \times 10^{-3} \times 3600 \\ &= 21600 \times 10^{-3} \\ &= 21.6 \text{ m}^3/\text{hr.} \quad \underline{\underline{}}$$

$$\text{Ans} \rightarrow \frac{18 \times 10 \times 8}{72} = \frac{18 \times 100 \times 8}{729} = 200 \text{ hrs.}$$

Ex A certain no. of taps filled a tank in $\frac{7}{2}$ hrs. If there were 4 taps less, the tank would have filled in 11 hours. Find the no. of taps.

$$\frac{n}{x} = \frac{1}{\frac{7}{2}}$$

$$\frac{n-4}{x} = \frac{1}{11}$$

$$\Rightarrow \frac{1}{\frac{7}{2}} - \frac{4}{x} = \frac{1}{11}$$

$$\Rightarrow \frac{4}{x} = \frac{1}{\frac{7}{2}} - \frac{1}{11} = \frac{4}{77}$$

$$\Rightarrow x = \underline{\underline{77}}$$

$$\therefore n = \frac{77}{7} = \underline{\underline{11}}$$

Ex Working together A, B and C can complete a piece of work in 10 days. Is A's rate of work the highest among the rates of work A, B, C?

(i) B alone can complete in 25 days

(ii) A " " " " in 50 days.

$$\frac{1}{a} + \frac{1}{b} + \frac{1}{c} = \frac{1}{10}$$

(i) \rightarrow

$$\frac{1}{b} = \frac{1}{25} \quad \frac{1}{a} + \frac{1}{c} = \frac{1}{10} - \frac{1}{25} \quad \text{nothing about A.}$$

$$(ii) \rightarrow \frac{1}{a} = \frac{1}{50}$$

$$\frac{1}{b} + \frac{1}{c} = \frac{1}{10} - \frac{1}{50} = \frac{4}{50}$$

One of $\frac{1}{b}$ & $\frac{1}{c}$ has to be greater than $\frac{1}{50}$. So, ⁽ⁱ⁾ B is sufficient to answer.

Ex Find the time taken by 6 men, 4 boys and 3 women to complete a job.

(i) 2 boys and 3 women or 10 men and 3 boys can complete the job in 5 days.

(ii) 9 men and 3 boys OR 10 boys and 15 women can complete the job in 3 days.

$$(i) \rightarrow \frac{2}{b} + \frac{3}{w} = \frac{1}{5} \quad \frac{10}{m} + \frac{3}{b} = \frac{1}{5} \rightarrow \frac{6}{10}$$

$$\frac{6}{m} + \frac{4}{b} + \frac{3}{w}$$

$$\frac{6}{m} + \frac{10}{b} = \frac{3}{25}$$

multiply by $\frac{2 \cdot 2}{2}$.

$$\frac{2 \cdot 2}{b} + \frac{3 \cdot 3}{w} = \frac{1 \cdot 1}{5}$$

Can't solve

$$(ii) \left(\frac{9}{m} + \frac{3}{b} \right) = \left(\frac{10}{b} + \frac{15}{w} \right) = \frac{1}{3}$$

$$\times \frac{2}{3} \quad \frac{6}{m} + \frac{2}{b}$$

$$\times \frac{1}{5} \rightarrow \frac{2}{5} + \frac{3}{5}$$

∴ (ii) is sufficient

→ can find out $\left(\frac{6}{m} + \frac{4}{b} + \frac{3}{w} \right)$

Ex 2 men and 7 boys can do a piece of work in 14 days. 3 men and 8 boys can do the same piece of work in 11 days. Then, 8 men and 6 boys can do 3 times the work in how many days?

$$\frac{2}{m} + \frac{7}{b} = \frac{1}{14}$$

$$\frac{3}{m} + \frac{8}{b} = \frac{1}{11}$$

$$\frac{6}{m} + \frac{16}{b} = \frac{2}{11}$$

$$\Rightarrow \frac{5}{b} = \frac{3}{14} - \frac{2}{11} = \frac{33 - 28}{154} = \frac{5}{154}$$

$$\Rightarrow \frac{1}{b} = \frac{1}{154}$$

$$\frac{1}{m} = \left(\frac{1}{14} - \frac{1}{154} \right) \times \frac{1}{2} = \frac{1}{2} \left(\frac{1}{14} - \frac{1}{154} \right) = \underline{\underline{\frac{2}{154}}}$$

$$\text{Ans} \rightarrow \frac{3}{\frac{8 \times 2}{154} + \frac{6 \times 1}{154}} = \frac{3}{\frac{22}{154}} = \underline{\underline{21 \text{ days}}}$$

Ex Among 4 people A, B, C and D, A takes thrice as much as B to complete a piece of work. B takes twice as much time as C and C takes thrice as much time as D to complete the same work.

One group of three of the 4 men can complete the work in 13 days, while another group of 3 can so do in 31 days. Which of the groups that takes 13 days?

Time	A	B	C	D
	27d	9d	3d	d

Efficiency	A	B	C	D
	$\frac{1}{27d}$	$\frac{1}{9d}$	$\frac{1}{3d}$	$\frac{1}{d}$

$$B, C, D \quad \frac{1}{9d} + \frac{1}{3d} + \frac{1}{d} = \frac{9+3+1}{9d} = \frac{13}{9d}$$

Time
9d/13

$$A, B, D \quad \frac{1}{27d} + \frac{1}{9d} + \frac{1}{d} = \frac{1+9+27}{27d} = \frac{31}{27d}$$

Time
27d
31

$$A, C, D \quad \frac{1}{27d} + \frac{1}{3d} + \frac{1}{d} = \frac{1+9+27}{27d} = \frac{37}{27d}$$

Time
37d
27d

$$A, B, C \quad \frac{1}{27d} + \frac{1}{9d} + \frac{1}{3d} = \frac{1+3+9}{27d} = \frac{13}{27d}$$

Time
27d
13

$$\text{If } d = \frac{31 \times 13}{27}, \quad (A, B, D) \text{ Time} = 13$$

$$(A, B, C) \text{ Time} = \frac{31}{27}$$

Ans $\rightarrow A, B, D$

Ex A tank is fitted with a pipe which fills it at 10 Litre/hr. After 4 hrs, a leak develops in the tank. If the leak had developed after 3 hrs instead of 4, it would have taken 2 hrs longer to fill the tank. How long would it take to fill the tank, if capacity 100L if the leak existed from the beginning?

~~$$\frac{4}{a} + (x-4) \times \left(\frac{1}{a} - \frac{1}{b} \right) = 1$$~~

$$\frac{3}{a} + (x-2) \left(\frac{1}{a} - \frac{1}{b} \right) = 1.$$

$$\Rightarrow \frac{4}{a} + (x-4) \left(\frac{1}{a} - \frac{1}{b} \right) = \frac{3}{a} + (x-2) \left(\frac{1}{a} - \frac{1}{b} \right)$$

$$\Rightarrow \frac{1}{a} = 2 \times \frac{1}{a} - 2 \times \frac{1}{b},$$

$$\Rightarrow \frac{1}{a} = 2 \times \frac{1}{b} = \text{Efficiency of } A = 2 \times \text{Efficiency of } B.$$

$$\text{Ans} \rightarrow \frac{100 \text{ L}}{10 - 5} = 20 \text{ hrs.}$$