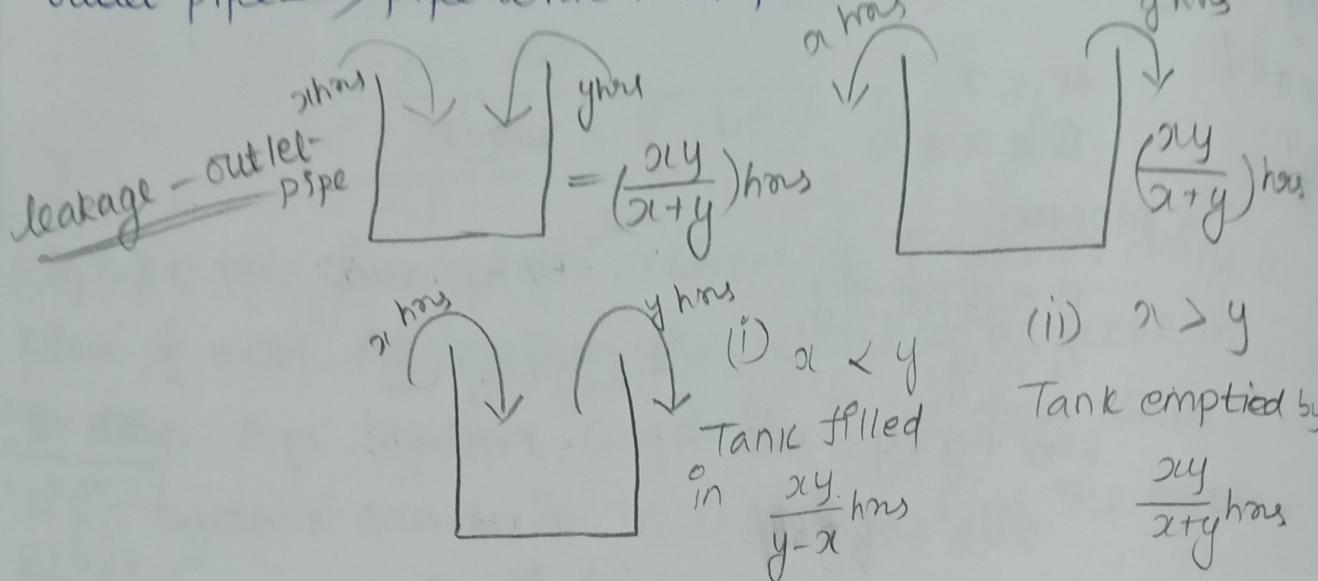


Pipes & Cisterns

Inlet pipe → pipe which fills the tank

outlet pipe → pipe which empties the tank



1. A tank can be filled by pipe A in 5 hrs & emptied by pipe B in 8 hrs. How much time will it take for the tank to be filled completely?

Soln:-

$$A = 5 \text{ hrs} \quad B = 8 \text{ hrs}$$

$$\Rightarrow \frac{ay}{y-x} = \frac{5 \times 8}{8-5}$$

$$= \frac{40}{3} \text{ hrs}$$

2. A pump can fill a tank with water in 2 hrs. Because of a leak the tank is filled in $2\frac{1}{3}$ hrs. In how many hrs the leak can empty the full tank?

Soln:-

$$\frac{8}{3} = \frac{2y}{2+y}$$

$$16 + 8y = 6y$$

$$2y = 16$$

$$(y = 8 \text{ hrs})$$

Q. Two pipes A & B can fill a cistern in 4 hrs. If they are opened separately, B would have taken 6 hrs more than A to fill the cistern. How much time will be taken by pipe A to fill the cistern completely?

Sln:- $A+B = 4 \text{ hrs}$

$A = x \text{ hrs}$

$B = x+6 \text{ hrs}$

$$4 = \frac{x(x+6)}{x+6+x}$$

$$4(x+6) = x^2 + 6x$$

$$8x + 24 = x^2 + 6x$$

$$x^2 + 6x - 8x - 24 = 0$$

$$x^2 - 2x - 24 = 0$$

$$x^2 - 6x + 4x - 24 = 0$$

$$x(x-6) + 4(x-6) = 0$$

$$x+4 = 0 \quad x-6 = 0$$

$$(x=-4) \times (x=6 \text{ hrs})$$

Q. Two pipes A & B can fill a tank in 24 min & 32 min respectively. If both the pipes are opened together (simultaneously) after how much time pipe B should be closed, so that the tank will be filled completely in 18 mins?

Sln:- $A = 24 \text{ mins} \quad B = 32 \text{ mins}$

$$18\left(\frac{1}{24}\right) + x\left(\frac{1}{32}\right) = 1$$

$$\frac{x}{32} = 1 - \frac{18}{24}$$

$$\frac{x}{32} = \frac{6}{24}$$

$$x = \frac{6 \times 32}{24}$$

$$(x = 8 \text{ mins})$$

5. Pipes A & B can fill a tank in 26 hrs & 48 hrs. Both pipes are opened together for 9 hrs & then pipe A is closed. In how many hrs Pipe B can fill the remaining part of the tank?

Soln:

$$A = 26 \quad B = 48$$

$$9\left(\frac{1}{36}\right) + (9+x)\left(\frac{1}{48}\right) = 1$$

$$\frac{1}{4} + \frac{9+x}{48} = 1$$

$$\frac{9+x}{48} = 1 - \frac{1}{4}$$

$$\frac{9+x}{48} = \frac{3}{4}$$

$$9+x = \frac{3 \times 48}{4} = 36$$

$$x = 36 - 9$$

$$\boxed{x = 27 \text{ hrs}}$$

6. Pipe A can fill a tank of capacity 350L in $3\frac{1}{2}$ minutes. Pipe B can fill a tank of capacity 780L in $8\frac{2}{3}$ minutes. How long it will take to fill a tank of capacity 1615L if both the pipes are opened together.

Soln:-

$$A - \frac{7}{2} \text{ min} \rightarrow 350 \text{ L}$$

$$B - \frac{26}{3} \text{ min} \rightarrow 780 \text{ L}$$

$$A \rightarrow 1 \text{ L} \Rightarrow \frac{\frac{1}{2}}{2 \times 350} = \frac{1}{100}$$

$$\frac{100 \times 90}{9000}$$

$$B \rightarrow 1 \text{ L} \Rightarrow \frac{\frac{1}{3}}{2 \times 780} = \frac{1}{90}$$

$$A+B = \frac{\frac{1}{100} \times \frac{1}{90}}{\frac{1}{100} + \frac{1}{90}} = \frac{\frac{1}{9000}}{\frac{190}{9000}} = \frac{1}{190}$$

$$1L \rightarrow A+B = \frac{1}{190} \quad \text{388}$$

$$1615L \rightarrow A+B \rightarrow \frac{1615}{190} \quad \text{88}$$

$$1615L = 8\frac{1}{2} \text{ min}$$

$$\begin{array}{r} 280 \\ 92 \\ \hline 248 \\ 228 \\ \hline 20 \\ 16 \\ \hline 12 \end{array}$$

4. Two pipes A & B can fill a tank in 16 hrs. They are opened alternately for one hour each starting with pipe A. In how many hours will the empty tank filled completely?

Soln: $A \rightarrow \frac{1}{16}, B \rightarrow \frac{1}{20}$

$\times 8 \text{ hrs } \xrightarrow{A+B} \frac{1}{16} + \frac{1}{20} \Rightarrow \frac{20+16}{16 \times 20} = \frac{36}{16 \times 20} = \frac{9}{80} \times 8$

$16 \text{ hrs } \xrightarrow{\text{Work completed}} \frac{72}{80} \text{ (work completed)}$

Remaining $\Rightarrow 1 - \frac{72}{80} = \frac{8}{80}$

$\frac{8}{80} \xrightarrow{17 \text{ hrs}} \frac{1}{16} \times \frac{5}{5} = \frac{5}{80} \checkmark$

$\frac{3}{80} \xrightarrow{18 \text{ hrs}} \frac{1}{20} \times \frac{4}{4} = \frac{4}{80} \Rightarrow \frac{3}{4} \text{ hrs}$

$\Rightarrow 17\frac{3}{4} \text{ hrs}$

5. Pipes A, B & C together can fill a cistern in 12 hrs. All the three pipes are opened together for 4 hrs & C is closed. A & B together take 10 hrs to fill the remaining part of the cistern. In how many hours pipe C can fill $\frac{2}{3}$ rd part of the cistern? Remaining part,

Soln: $A+B+C = 12 \text{ hrs} \quad A+B = 10$

$$A+B+C = \frac{4}{12} = \frac{1}{3} \quad 1 - \frac{1}{3} = \frac{2}{3}$$

$$10(A+B) = \frac{2}{3} \quad A+B = \frac{2}{30}$$

$$A+B+C = \frac{1}{12}$$

$$C = \frac{1}{12} - (A+B) = \frac{1}{12} - \frac{2}{30}$$

$$C = \frac{5-4}{60} = \frac{1}{60}$$

To fill complete tank,

$$C = 60$$

To fill $\frac{2}{3}$ rd

$$C = 60 \times \frac{2}{3},$$

$$\boxed{C=40 \text{ hrs}}$$

9. 3 pipes A, B & C together fill a tank in 4 hrs. Pipe C can fill the tank at twice the speed of pipe B, and pipe B can fill the tank at thrice the speed of pipe A. Find the time taken by pipe A to fill the complete tank.

Soln:

$$C=2B \quad B=3A \quad A=x$$

$$A+B+C = 4 \text{ hours}$$

$$\frac{1}{x} + \frac{3}{x} + \frac{6}{x} = \frac{1}{4}$$

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

$$\boxed{x=40 \text{ hrs}}$$

10. Three pipes A, B & C can fill a cistern 15, 20 & 30 min. They are all turned on at the same time but after 5 minutes first two pipes are turned off. How long it will take to fill the cistern completely?

Soln:

$$5\left(\frac{1}{15}\right) + 5\left(\frac{1}{20}\right) + (5+x)\left(\frac{1}{30}\right) = 1$$

$$\frac{5+x}{30} = 1 - \left(\frac{5}{15} + \frac{5}{20}\right)$$

$$\frac{5+x}{30} = 1 - \left(\frac{20+15}{60} \right)$$

$$\frac{5+x}{30} = 1 - \frac{35}{60} = \frac{25}{60}$$

$$5+x = \frac{25 \times 30}{60}$$

$$x = \frac{25}{2} - 5$$

$$x = \frac{25-10}{2}$$

$$x = \frac{15}{2} = 7.5$$

Total time = $5 + 7.5$
= 12.5 mins

11. Pipes A & B can fill a tank in 16 hrs & 24 hrs respectively
& pipe C alone can empty the tank in x hrs. All the pipes
are opened together at 10.30 AM but C is closed at 2.30 PM
If the tank was filled at 8.30 PM on the same day.

Soln:-

$$10\left(\frac{1}{16}\right) + 10\left(\frac{1}{24}\right) - 4\left(\frac{1}{x}\right) = 1$$

$$\frac{10}{16} + \frac{10}{24} = 1 + \frac{4}{x}$$

$$\frac{50}{48} - 1 = \frac{4}{x}$$

$$\frac{2}{48} = \frac{4}{x}$$

$$2x = \frac{4 \times 48}{2}$$

$$x = 96 \text{ hrs}$$

12. Two pipes can fill the tank in 25 minutes & 30 mins respectively. And a waste pipe can empty 3 Gallons per minute. All the 3 pipes working together can fill the tank in 15 minutes. Find the capacity of the tank.

Soln:

$$A + B + C = \frac{1}{15}$$

$$\frac{1}{25} + \frac{1}{30} - \frac{1}{x} = \frac{1}{15}$$

$$\frac{1}{x} = \frac{1}{25} + \frac{1}{30} - \frac{1}{15}$$

$$\frac{1}{x} = \frac{6+5-10}{150} = \frac{1}{150}$$

$$\frac{1}{x} = \frac{1}{150}$$

$$x = 150 \text{ mins}$$

$$1 \text{ min} \rightarrow 3 \text{ gallons}$$

$$150 \text{ min} \rightarrow 3 \times 150$$

$$= 450 \text{ gallons}$$

13. A tap can fill a tank in 4 hrs, after half of the tank is filled two similar taps are opened. What is the total time taken to fill the tank completely?

Soln:

$$\text{tap} - \frac{1}{4}$$

$$2 \text{ hrs} \xrightarrow{\text{1 Pipe}} \text{half filled} \rightarrow \frac{1}{2} \text{ tank}$$

$$1 \text{ tap} \xrightarrow{1 \text{ hr}} \frac{1}{4}$$

$$3 \text{ tap} \xrightarrow{1 \text{ hr}} \frac{3}{4} \text{ (tank can be filled)}$$

$$\frac{3}{4} \Rightarrow 60 \text{ min}$$

$$1 \rightarrow 60 \times \frac{4}{3} = 80 \frac{1}{2}$$

$$\frac{1}{2} t = 40 \text{ mins}$$

$$\boxed{\text{Total} = 2 \text{ hrs } 40 \text{ mins}}$$

14) 4 pipes can fill a tank in 15, 20, 30, 60 hrs respectively. The first pipe was opened at 6 am, second at 7 am, third at 8 am and 4th at 9 am. At what time the tank will be filled completely?

Soln:-

$$A \rightarrow \frac{1}{15} \quad B \rightarrow \frac{1}{20} \quad C \rightarrow \frac{1}{30} \quad D \rightarrow \frac{1}{60}$$

let tank is filled after x hrs.

from 6 Am

$$A \rightarrow x \text{ hrs}$$

$$B \rightarrow x-1 \text{ hrs}$$

$$C \rightarrow x-2 \text{ hrs}$$

$$D \rightarrow x-3 \text{ hrs}$$

$$x\left(\frac{1}{15}\right) + (x-1)\left(\frac{1}{20}\right) + (x-2)\left(\frac{1}{30}\right) + (x-3)\left(\frac{1}{60}\right) = 1$$

$$\frac{4x+3x-3+2x-4+x-3}{60} = 1$$

$$\frac{10x-10}{60} = 1$$

$$\frac{x-1}{6} = 1$$

$$x-1 = 6$$

$$\boxed{x=7}$$

\rightarrow 7 hrs after 6 am \rightarrow 1 PM

15) A water tap can be filled ~~hrs after 6 am~~

15) A water tub can be filled by 2 taps in 8 mins. One tap is closed after 3 mins. The other tap fills the remaining tub in 15 mins. How much time will the faster tap takes to fill the tub completely?

Soln:-

$$A+B = 8$$

$$8 = \frac{24y}{24+y}$$

$$8(24+y) = 24y$$

$$24y = 3y$$

$$2y = 24$$

$$\boxed{y = 12}$$

$$3\left(\frac{1}{8}\right) + 15\left(\frac{1}{21}\right) = 1$$

$$\frac{15}{21} = 1 - \frac{3}{8} = \frac{5}{8}$$

$$21 = \frac{15 \times 8}{5} = 24$$

16. Three pipes A, B & C can fill a tank in 30 mins, 20 mins & 10 mins. When the tank is empty all the three pipes are opened. Pipes A, B & C discharge chemical solutions, P, Q & R respectively. What is the proportion of solution R in the liquid in the tank after 3 minutes?

Soln:

$$\begin{array}{l} \text{Time} \quad A : B : C \\ \text{ratio} \quad 3 : 2 : 1 \end{array} \quad \text{solution discharged} \propto \frac{1}{\text{time}}$$

$$\left[\frac{1}{3} : \frac{1}{2} : \frac{1}{1} \right] \times 6$$

$$2 : 3 : 6 \Rightarrow \frac{6}{11}$$